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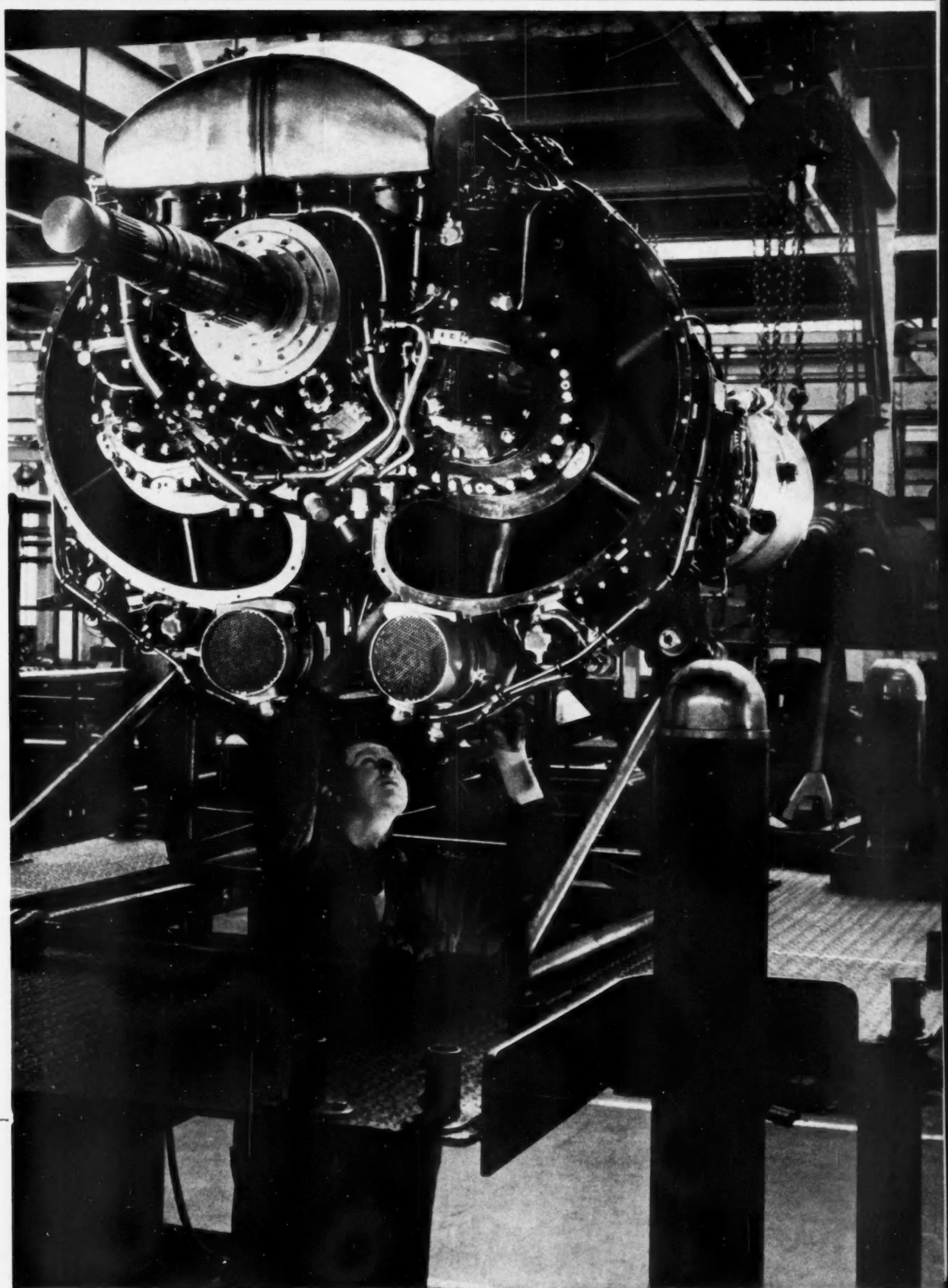

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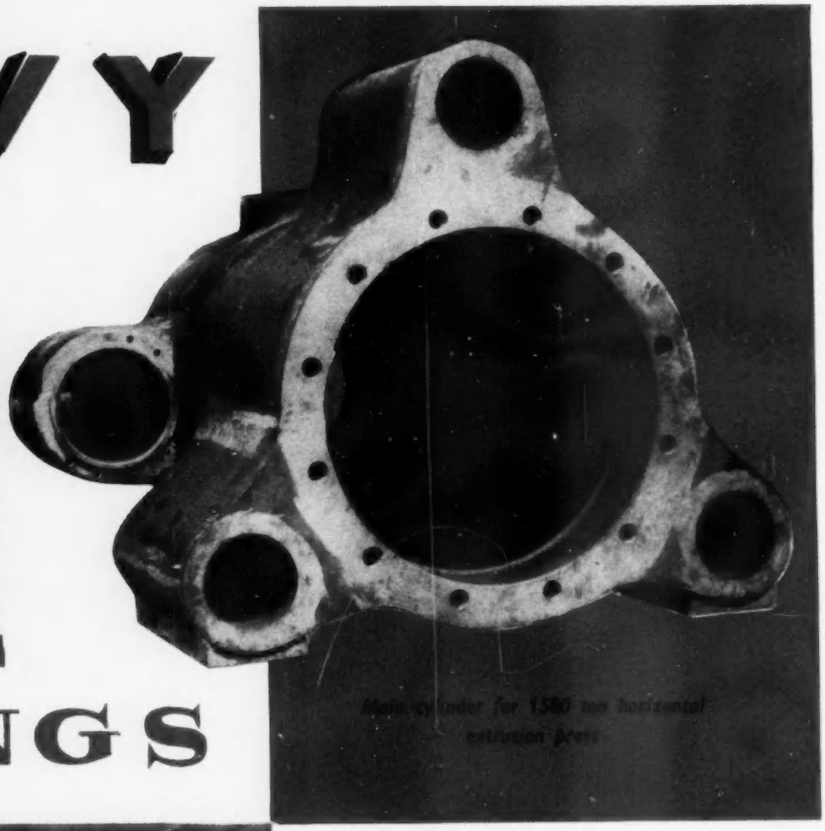
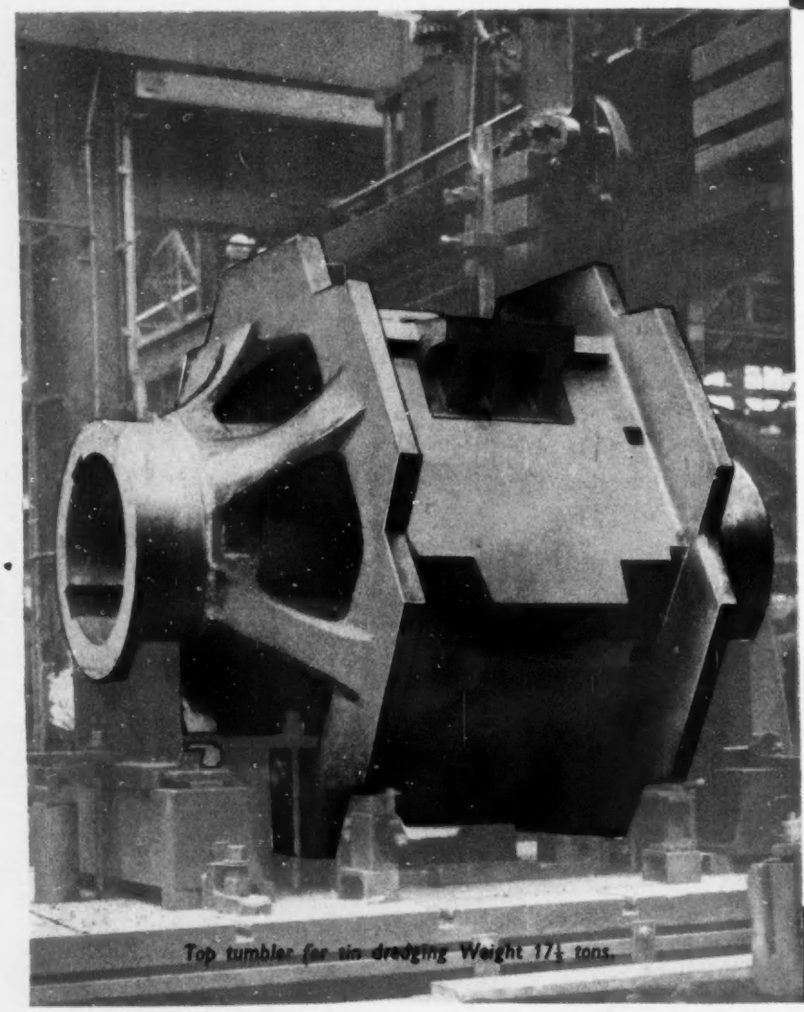


Main cylinder for 1580 ton horizontal extrusion press



Top tumbler for tin dredging. Weight 17½ tons.

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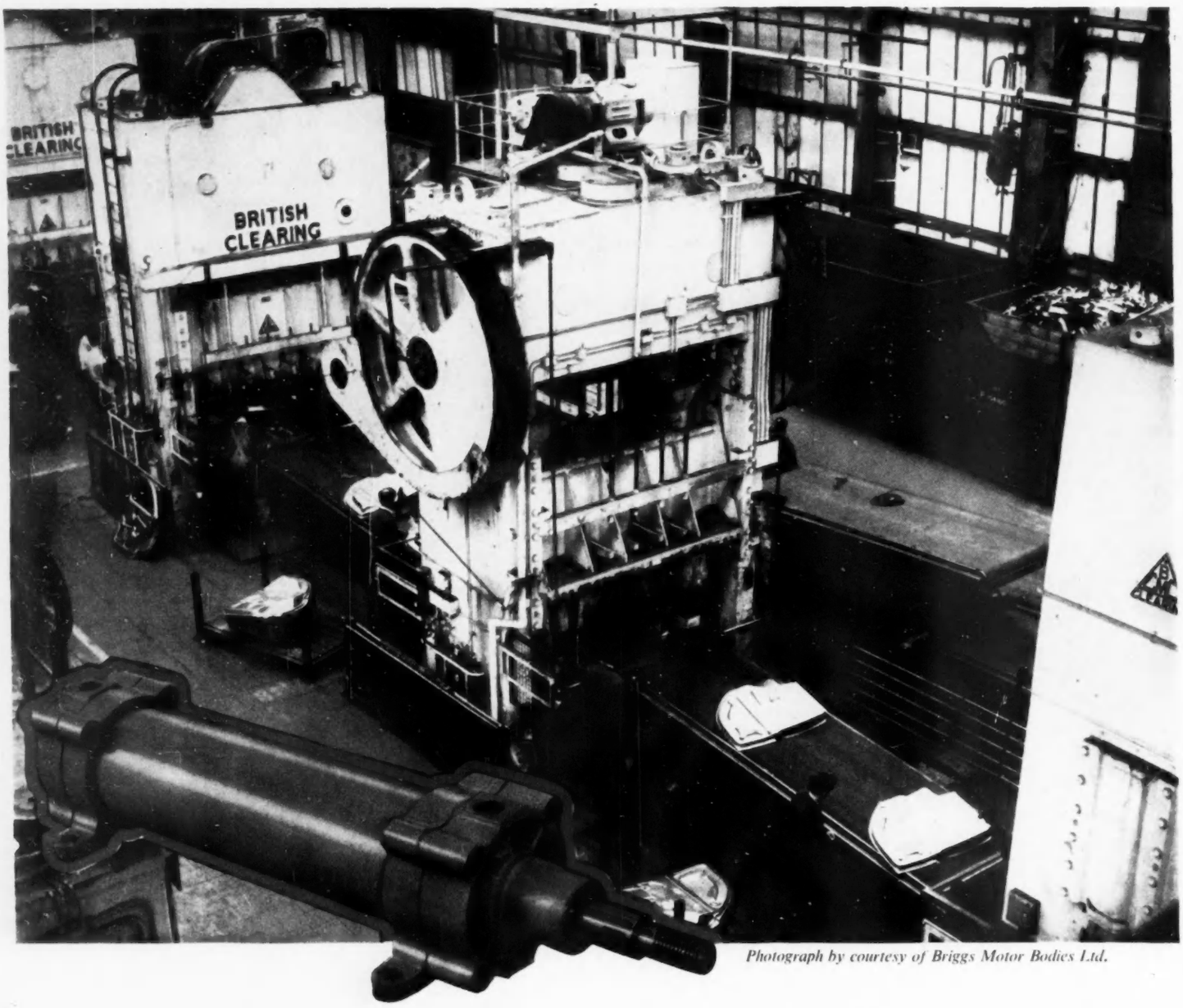

Photograph by courtesy of Briggs Motor Bodies Ltd.

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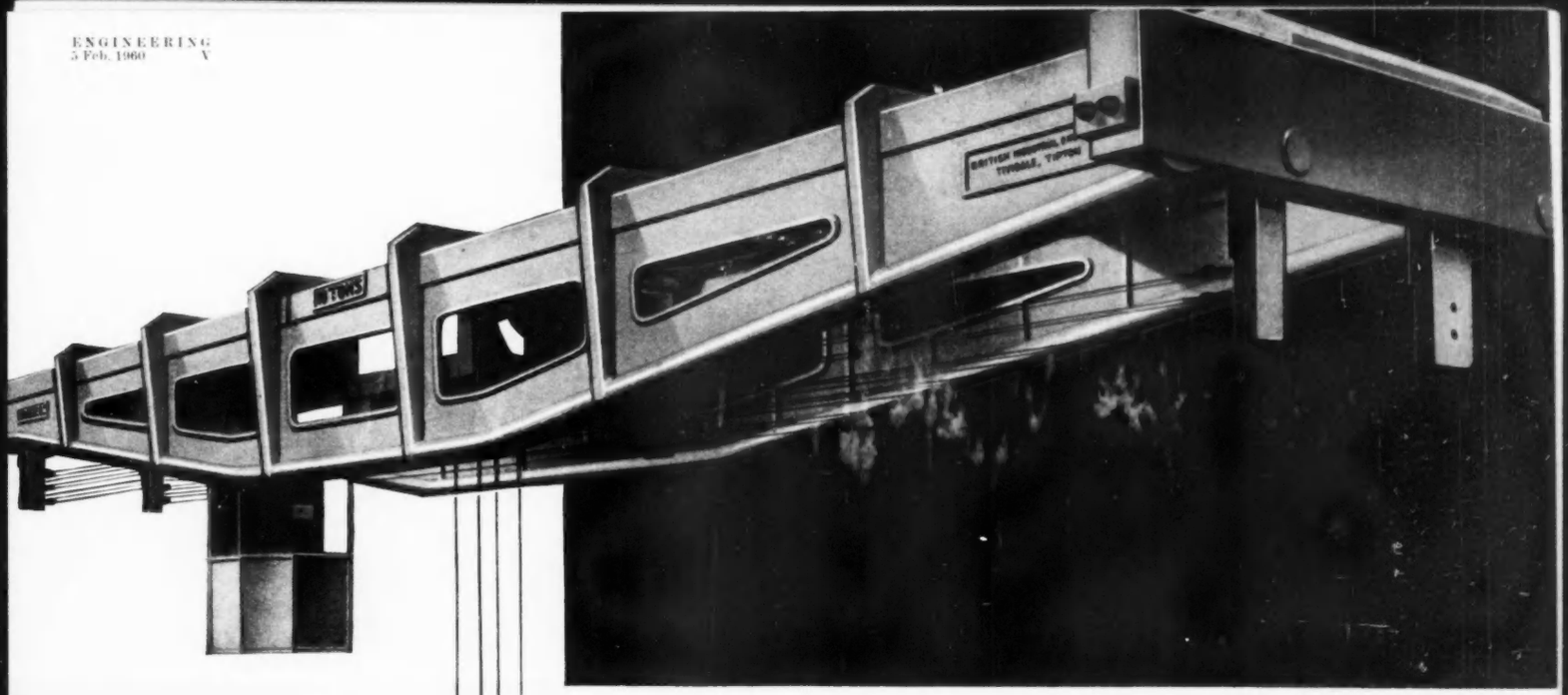

Manufactured under licence from Ferrand & Frantz Ing. Villeurbanne. British Patent No. 705,148.

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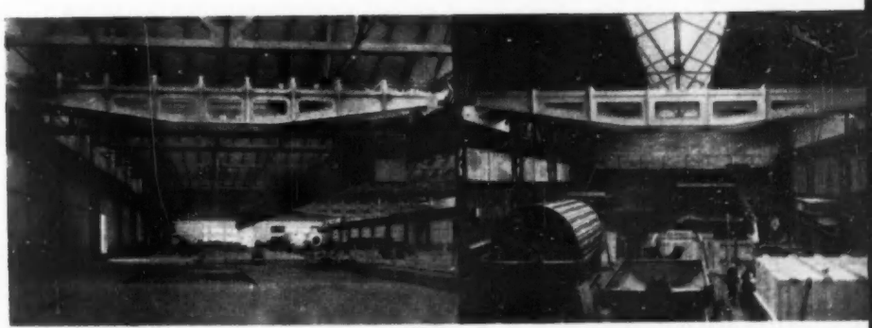

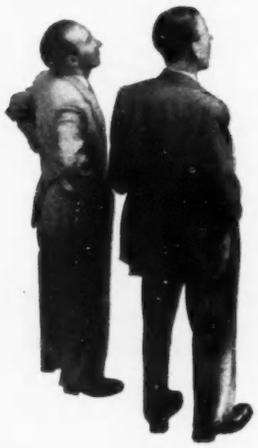

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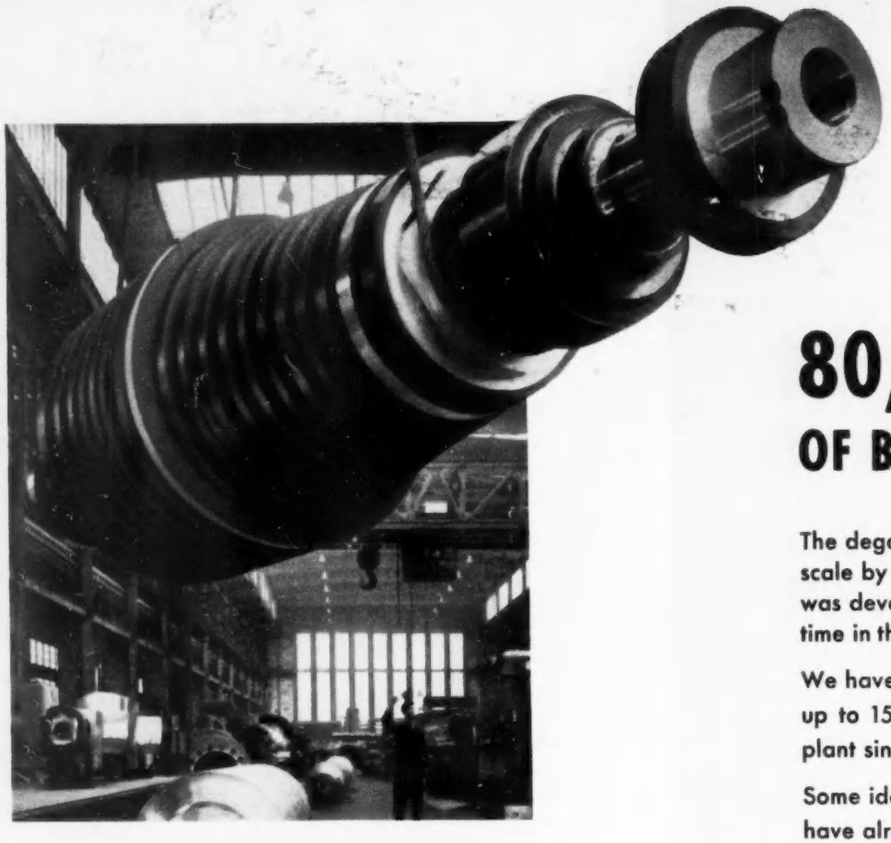

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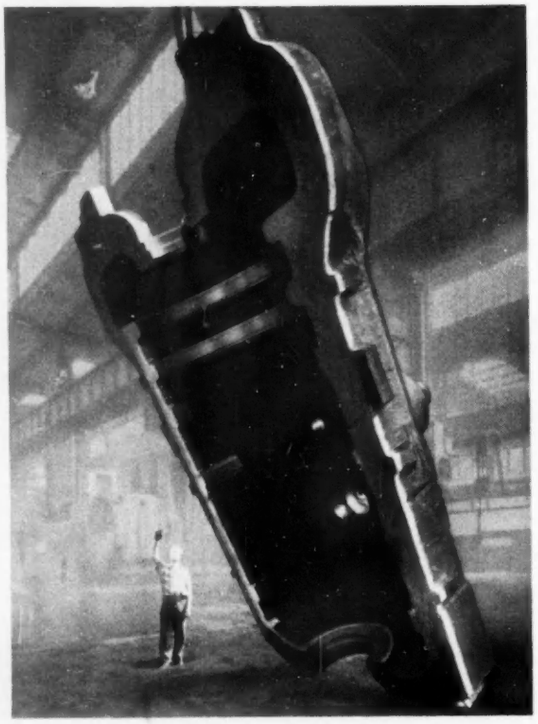

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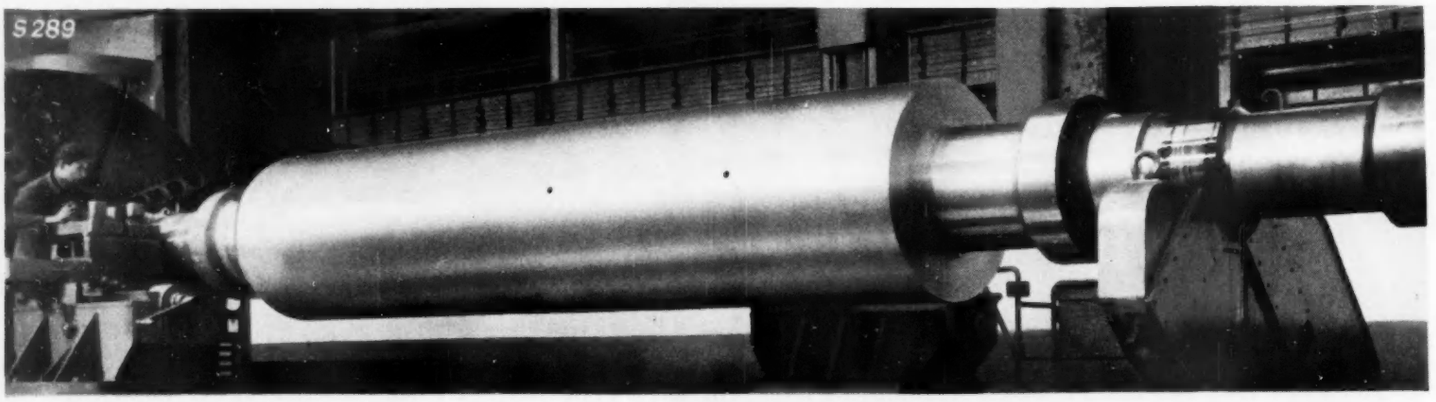

5 February 1960

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36 Bedford Street London WC2 England Telephone: Temple Bar 3663

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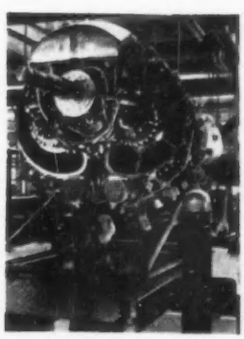

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Front view of turbo-prop aircraft engine mounted on a hydraulic servicing platform. (*Nurnberg photograph for* ENGINEERING.)

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Particulars and application forms from HEAD OF CHEMISTRY DEPARTMENT. A 978

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Forms of tender may be obtained from the above address on or after the 5th FEBRUARY, 1960, upon payment of a fee of 10s., which is not returnable. If payment is made by cheque, it should please be made payable to "High Commissioner for India." Tenderers must send their tenders so as to reach this Office by 2 p.m. on Thursday, 10th MARCH, 1960.
Please quote Reference No. 59/59.DB/RLY.2.
B 244

MUDI RIVER WATER BOARD, NYASALAND

NOTICE TO CONTRACTORS

TENDERS are invited from manufacturers for the supply, delivery and erection of **PUMPING PLAN** supply, delivery and erection of **PUMPING PLANT** in the BLANTYRE DISTRICT OF NYASALAND FOR CONTRACT NO. 3 OF THE WALKER'S FERRY SCHEME.

The Contract includes for the supply, delivery and erection of the following electric motor driven pumping equipment:—

(i) Submersible pump/motor sets or spindle-driven bore-hole pump/motor sets to pump raw water. Four units. Voltage 400. Capacity: 41,750 g.p.h. Maximum Pumping Head: 130 feet.
(ii) High lift pump/motor sets to pump treated water at Walker's Ferry. Two units. Voltage 3300. Capacity: 41,750 g.p.h. Maximum Pumping Head: 1385 feet.
(iii) High lift pump/motor sets to pump treated water at Chileka. Two units. Voltage: 3300. Capacity: 41,750 g.p.h. Maximum Pumping Head: 1350 feet.
(iv) Medium lift pump/motor sets to pump treated water at Soche. Two units. Voltage 400. Capacity: 41,750 g.p.h. Maximum Pumping Head: 330 feet.

The Contract also includes for the supply, delivery and erection of electric motor starters, instruments and controls, raw water screens, station valves, sluices and pipework and other ancillary equipment described in the documents.

All concrete and building work will be carried out under a separate contract.

Tender documents in triplicate may be obtained from the CONSULTING ENGINEERS, MESSRS. SCOTT & WILSON, KIRKPATRICK & PARTNERS, P.O. BOX 154, BLANTYRE, NYASALAND, or 47, VICTORIA STREET, LONDON, S.W.1, ENGLAND, on or about the 1st February, 1960, on payment of a deposit of twenty pounds sterling in the form of a Banker's draft only, in favour of the Mudi River Water Board. This amount will be refunded on receipt of a *bona fide* tender or the return of all contract documents.

Tenders in sealed packages shall be endorsed and addressed in the manner stated in the instruction contained in the documents and shall be delivered at the stated addresses not later than 14.00 hours G.M.T. on Tuesday, 10th May, 1960.

The Mudi River Water Board does not bind itself to accept the lowest or any tender.

ALEXANDER MILLER, A.M.I.C.E., M.I.Mun.E., M.I.W.E.,
ENGINEER MANAGER,
MUDI RIVER WATER BOARD,
P.O. BOX 369,
LIMBE, NYASALAND.
B 212

CITY COUNCIL OF GEORGE TOWN, PENANG

TENDERS are INVITED for the **SUPPLY** and **DELIVERY,** c.i.f. PENANG PORT, of a **750 KW WATERWHEEL DRIVEN INDUCTION GENERATOR AND ACCESSORIES.**

The contract now advertised will comprise a Waterwheel, Induction Generator, buffer reactor, capacitor, valves, Pipework, and a small hand-operated crane, etc.

Tenders are invited only from firms who are prepared to submit complete tenders.

TENDER DOCUMENTS, which will be AVAILABLE FROM 5TH FEBRUARY, 1960, and RETURNABLE by the 9th MAY, 1960, may be OBTAINED on application to MESSRS. PREECE, CARDEW & RIDER, 8, 10 and 12 QUEEN ANNE'S GATE, LONDON, S.W.1.

THE CITY COUNCIL OF PENANG do not bind themselves to accept the lowest or any Tender, nor will they be responsible for any costs incurred by Tenderers in making their Tender.

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THE OFFICE OF INDIA SUPPLY MISSION 2536, MASSACHUSETS AVENUE, N.W., WASHINGTON 8, D.C., UNITED STATES OF AMERICA, invites **TENDERS** for the following:

TENDER ENQUIRY NO. SE.139

"For the supply of 2 Nos. borehole pumps; 200 g.p.m. against 200 ft. hd. Max. diameter of pump to be 7¼ inches."

Specifications, etc., relative to the above, can be obtained from the Coordination Branch, India Store Department, Bromyard Avenue, Acton, W.3, at a cost of 14 shillings and 3 pence per tender, and is not refundable. Tenders are to be returned direct to India Supply Mission, 2536, Massachusetts Avenue, N.W. Washington 8, D.C., United States of America, so as to reach them by 22nd March, 1960.

Specimen copy of the above enquiry can be seen at INDIA STORE DEPARTMENT ENGINEERING BRANCH, BROMYARD AVENUE, ACTON, W.3, under the following reference:—S.3926/59/NSC/ENG.2. B 252

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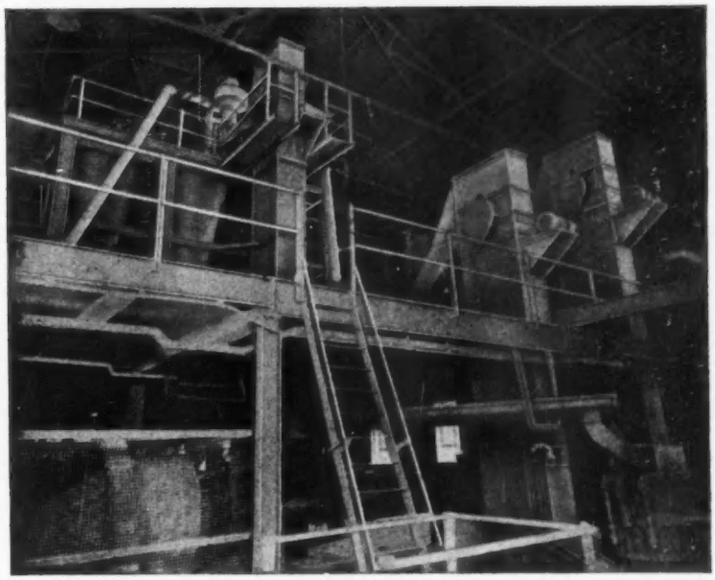

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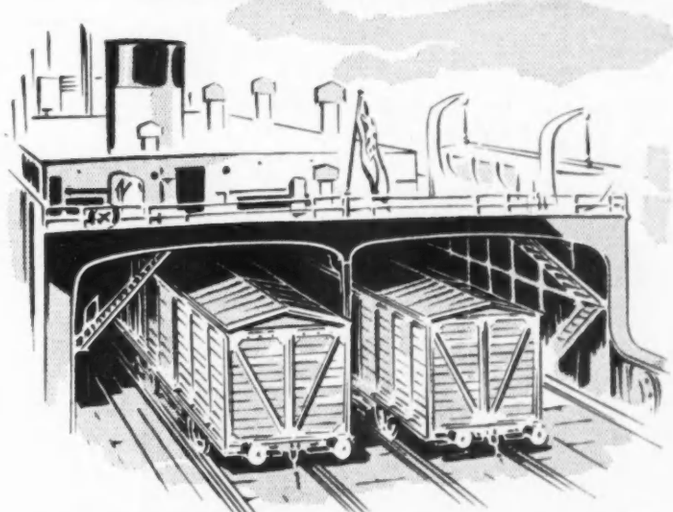

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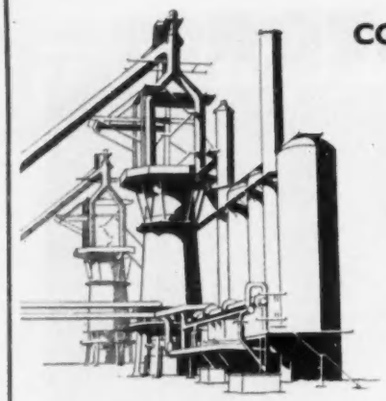

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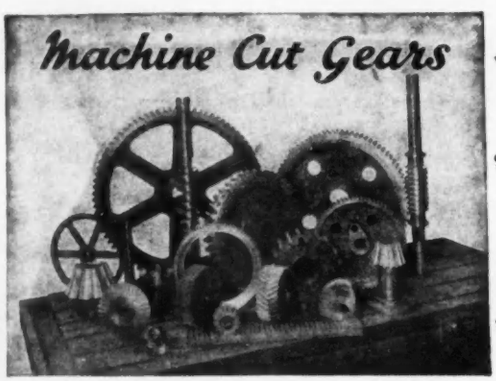

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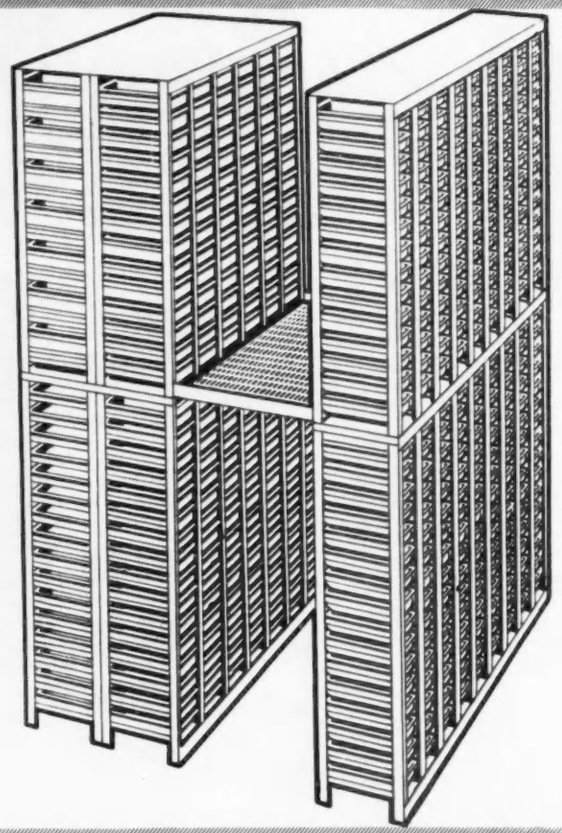

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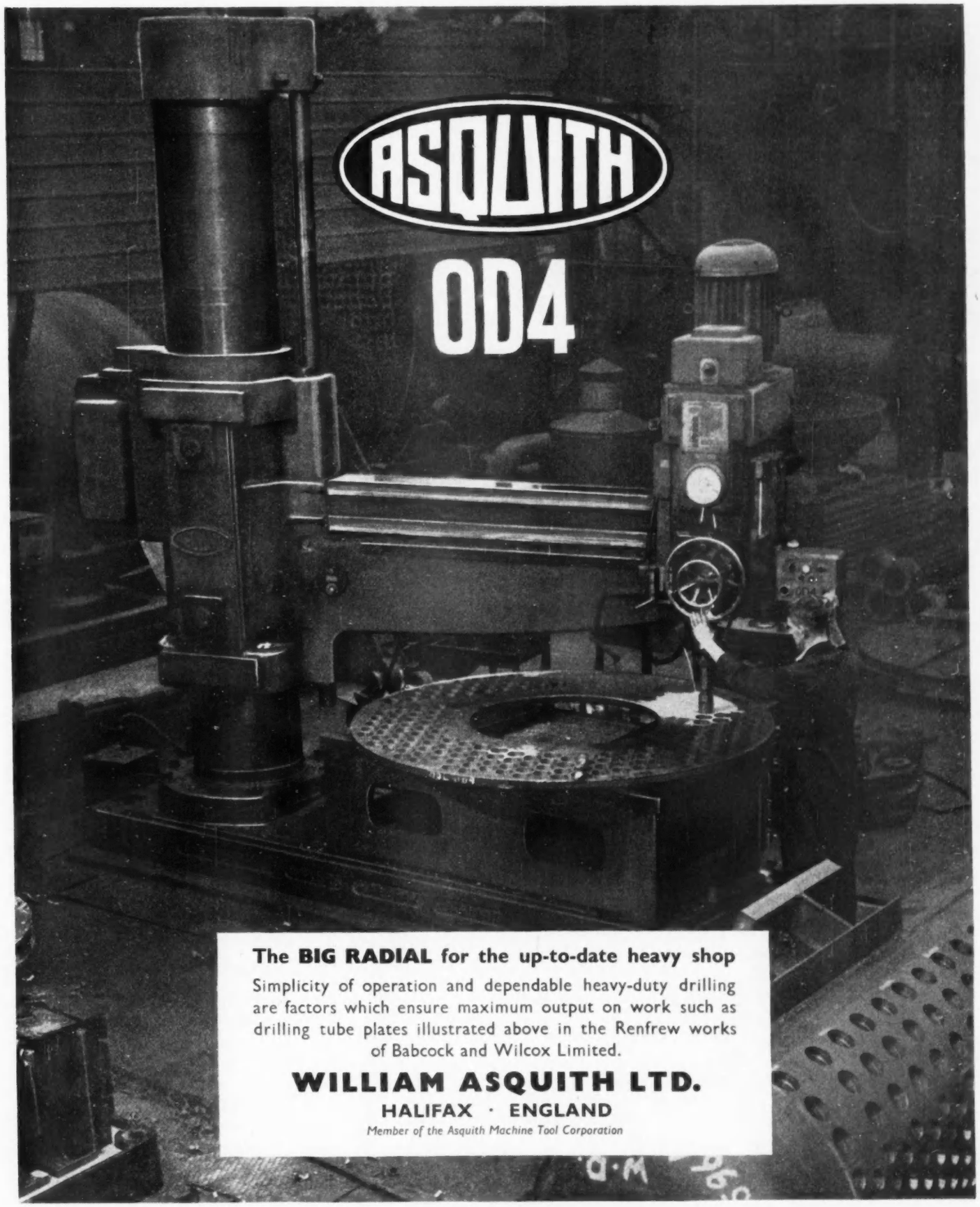

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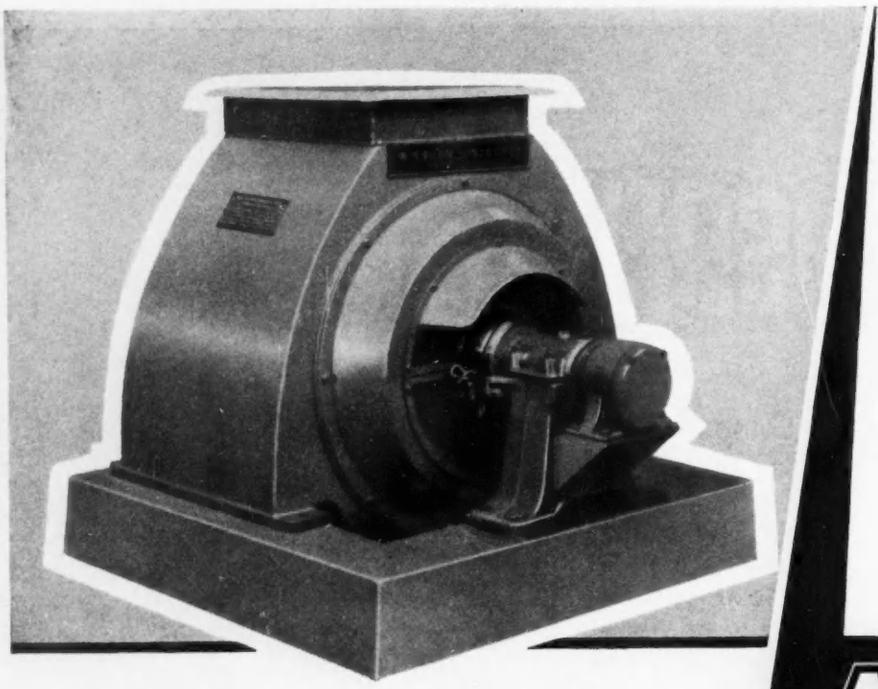

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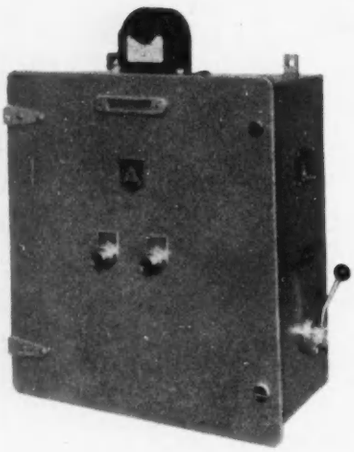

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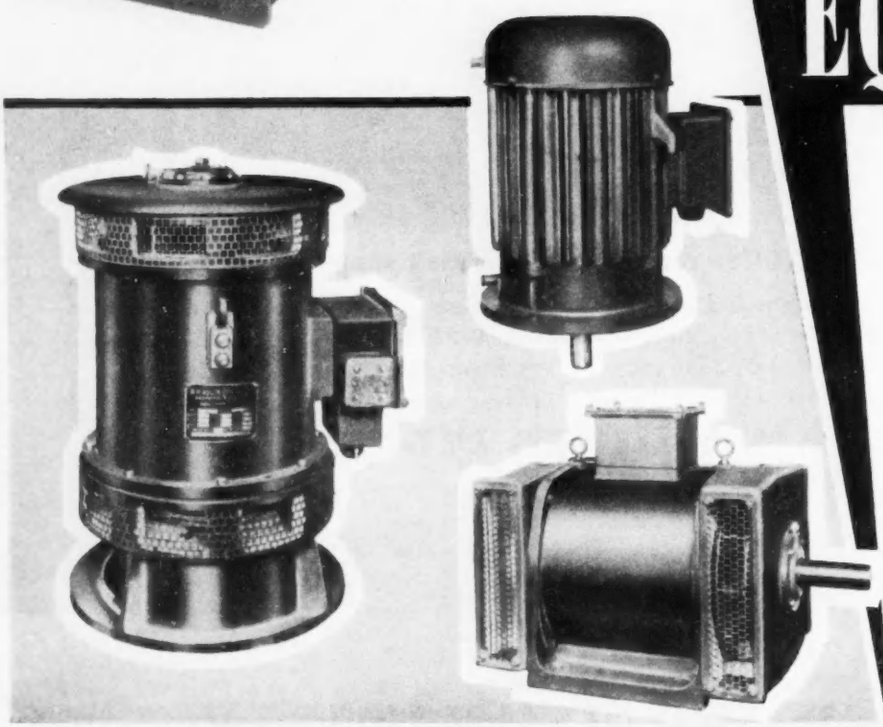

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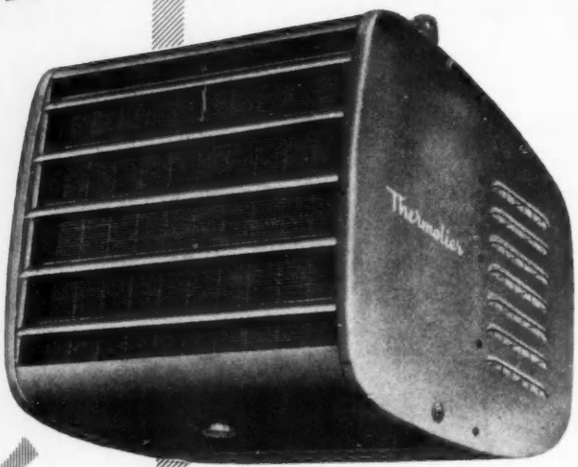

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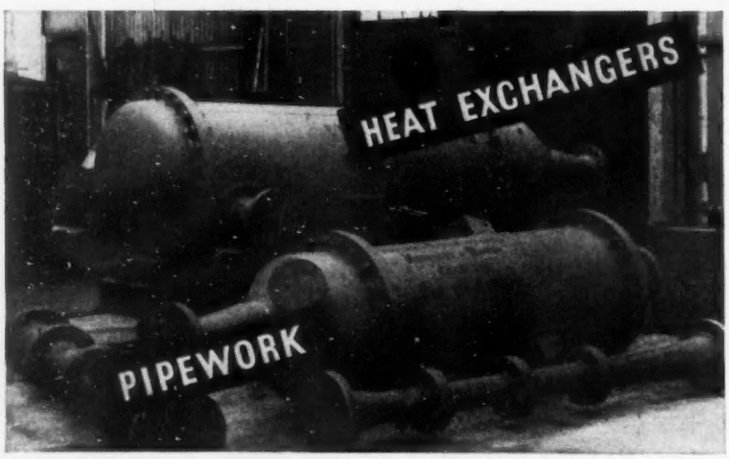

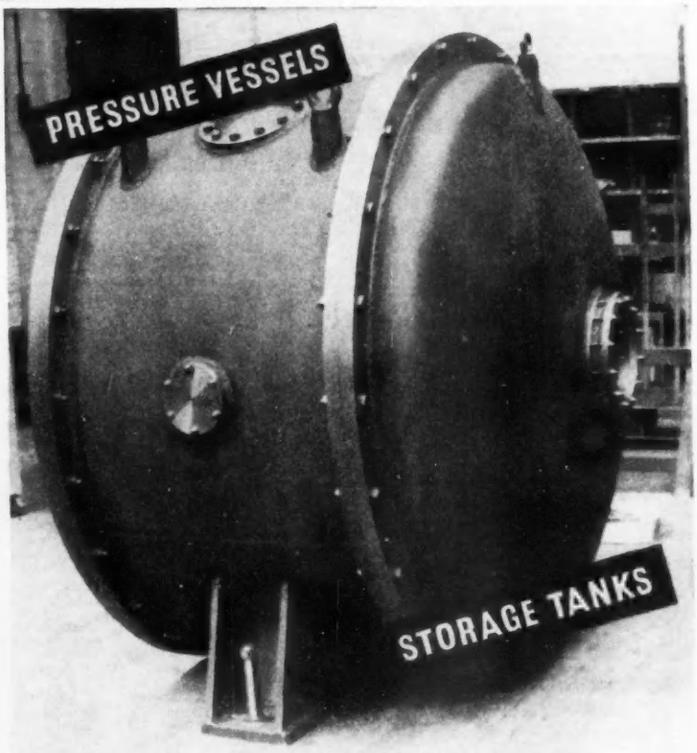

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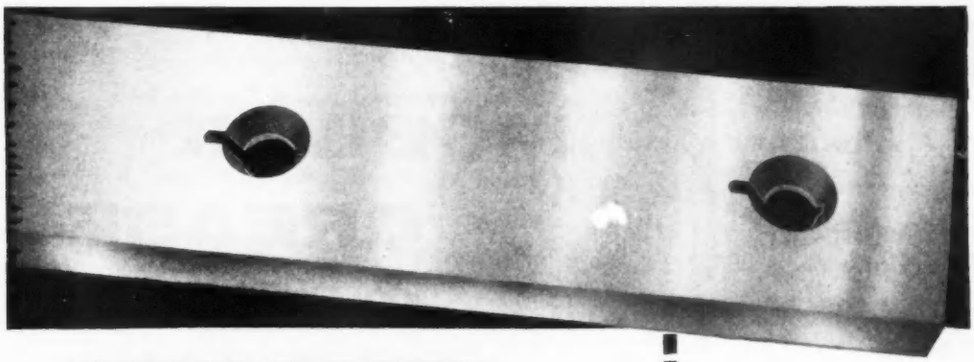

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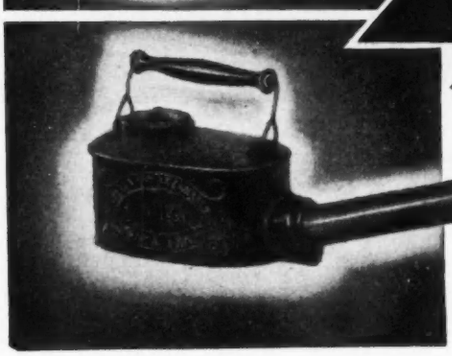

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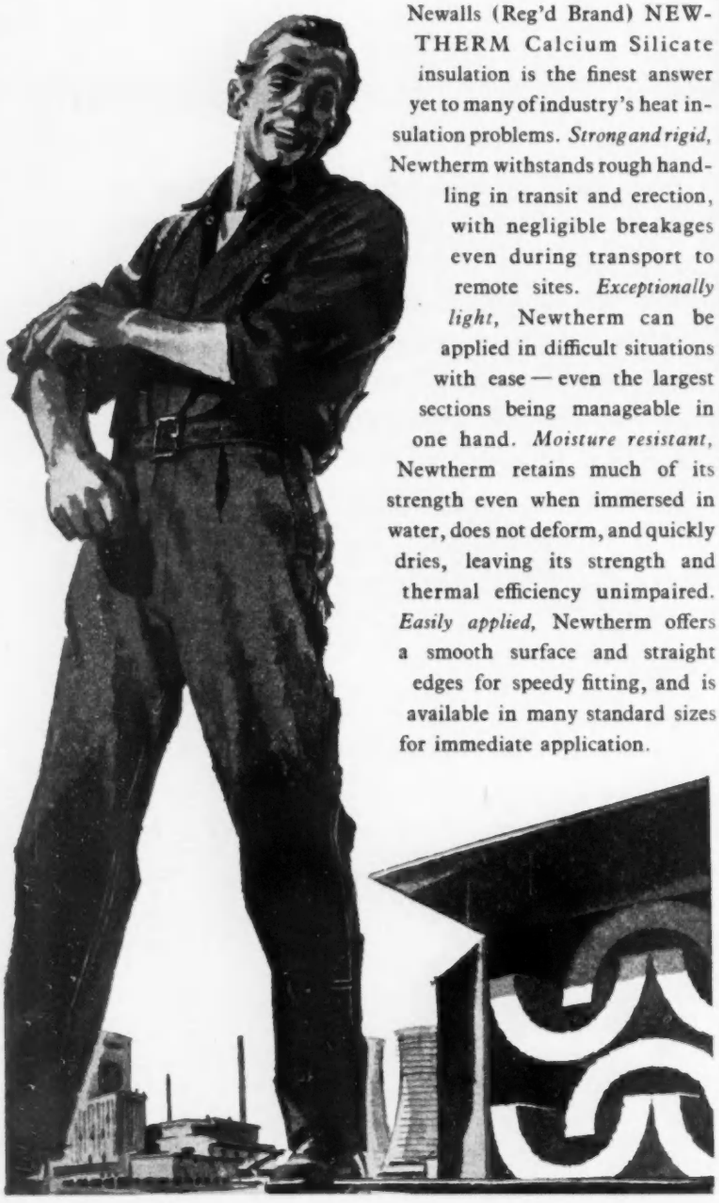
give NEWTHERM your toughest insulation assignment



Newalls (Reg'd Brand) NEWTHERM Calcium Silicate insulation is the finest answer yet to many of industry's heat insulation problems. *Strong and rigid,* Newtherm withstands rough handling in transit and erection, with negligible breakages even during transport to remote sites. *Exceptionally light,* Newtherm can be applied in difficult situations with ease — even the largest sections being manageable in one hand. *Moisture resistant,* Newtherm retains much of its strength even when immersed in water, does not deform, and quickly dries, leaving its strength and thermal efficiency unimpaired. *Easily applied,* Newtherm offers a smooth surface and straight edges for speedy fitting, and is available in many standard sizes for immediate application.

NEWTHERM Calcium Silicate is manufactured solely by

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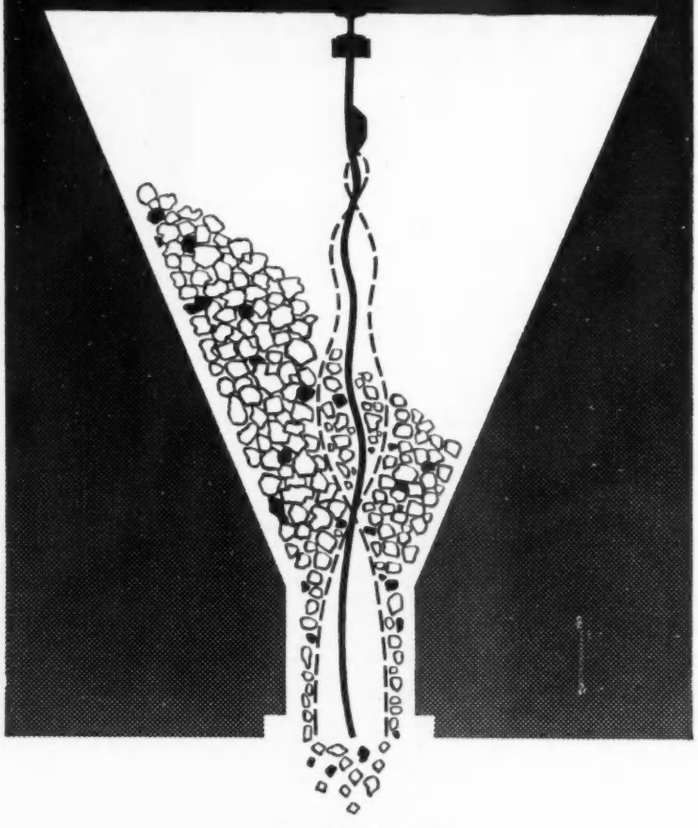
Efficient Bunker Discharge



The problems of efficient discharge of material from large storage bunkers where external vibration is impractical is simply overcome by the installation of the new Sinex Internal Bunker Vibrator. The device comprises a Sinex rotary electric vibrator attached to a steel reed which hangs down into the bunker. The unit is suspended from a rolled steel joist and anti-vibration mountings protect the hopper structure itself. Maximum amplitude occurs at the tip of the reed or at the point where stoppage has built up, releases the material and ensures a smooth, free flow. Sinex Internal Bunker Vibrators are completely reliable, the power unit being readily accessible and causing no obstruction to the material inside the hopper.

Sinex

INTERNAL BUNKER VIBRATOR

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Opportunity for distribution rights are still available in some areas.

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ASSOCIATED COMPANIES IN PARIS, BRUSSELS AND ZURICH

International NU-SWIFT News

No. 2

HAVE YOU MET THESE PEOPLE?

HAVE YOU BEEN TO THESE PLACES?

25. Since MOROCCO gained her independence, a Nu-Swift sales concessionaire has been appointed and the first supplies of extinguishers have been shipped to glamorous CASABLANCA.

26. Narrow and winding alleyways in the ancient town of ST. GEORGE, first BRITISH settlement in now fashionable BERMUDA, sometimes prevent the Fire Brigade from getting close enough for effective fire fighting. Fire engines are therefore fitted with extinguishers to enable firemen to fight inaccessible fires with reliable Nu-Swift.

27. A.T.A.C. the MUNICIPAL TRAFFIC COMBINE of the City of ROME, and reputed to be the largest surface passenger transport organization in Europe has decided, after tests extending over two years, to standardize on Nu-Swift.

28. YUGO-SLAVIAN STATE-OWNED CORPORATIONS are among the Nu-Swift customers situated on the edge of the East-West iron curtain.

29. In HELSINKI, capital of gallant little Finland, and almost within a taxi ride of Leningrad, the FINNISH POSTS AND TELEGRAPHS DEPARTMENT have decided to standardize on Nu-Swift Dry Powder extinguishers, especially suitable for use under severe arctic conditions, common each winter in Northern Finland. Substantial orders have already been placed.

30. GERMAN SHIPOWNERS are now also able to fit Nu-Swift in their ships, thanks to the approval of the SEE-BERUFS-GENOSSENSCHAFT in Hamburg.

31. At TULLIN, Austria, in the presence, of high ranking Austrian fire fighting officials including BRANDDIREKTOR DUFEK, Chief Fire Officer of Vienna, two Nu-Swift Dry Powder Extinguishers, Model 1604, bonded for 2 years for reliability tests were recently discharged. They passed with flying colours and OBERBRANDRAT SPEIL the official responsible, signed the certificate of approval on the spot.

32. The Government of the FALKLAND ISLANDS, British sheep farming colony in the South Atlantic, near Argentina, recently placed their first Nu-Swift order. Sheep vastly outnumber human inhabitants in the Colony, previously of great strategic importance, but GREASY WOOL has high fire risk.

33. INDEPENDENT TELEVISION AUTHORITY, always in keen competition with the BBC, is determined that programme transmission shall never be interrupted through preventible causes. All its stations are now protected by Nu-Swift.

34. Reputedly being let at £25 a day or more, NEW LUXURY SUITES on the top floor of the DORCHESTER, London's premier Park Lane Hotel, are protected by Nu-Swift.

35. The up-to-date works of ALFA ROMEO, the well-known motor car manufacturers in NORTHERN ITALY, have recently been equipped with Nu-Swift. Crash tenders too have been fitted with fast and reliable Nu-Swift.

36. In NASSAU, BAHAMAS, eldorado of all YACHTING AND DEEP-SEA FISHING enthusiasts, many of the YACHTS are equipped with Nu-Swift.

37. PRINCESS BENEDIKTE, teenage daughter of the King of Denmark, recently launched a large train ferry named after her at ELSINORE close to the legendary home of Hamlet. Required urgently by the DANISH STATE RAILWAYS to cope with increase in cross-water traffic, the ferry was equipped with Nu-Swift.

38. The Trustees of SHAKESPEARE'S Birthplace in STRATFORD-ON-AVON, conscious of the dollar-earning value of the Bard'shome, have protected the property with Nu-Swift. Last year the house was visited by over 200,000 sightseers.

39. H.M. THE KING OF SWEDEN has had Nu-Swift fitted in his cars and other vehicles. On board H.S.M.S. 'TRE KRONOR,' Sweden's premier man-of-war, His Majesty is similarly protected. Three other reigning Sovereigns are also protected on board their yachts by Nu-Swift.

40. ESSO RESEARCH, LTD. have equipped their new offices at ABINGDON BERKS., ENGLAND, with Nu-Swift.

41. The UNITED KINGDOM ATOMIC ENERGY AUTHORITY has protected DOUNREAY EXPERIMENTAL REACTOR ESTABLISHMENT in remote CAITHNESS in the North of Scotland with reliable Nu-Swift. The U.K.A.E.A. has some fire risks: The fire in 1957 at their Windscale No. 1 pile cost £1,967,826.

42. KUNGL. SJÖ FARTSSTYRELSEN, progressive Sweden's Ministry of Transport, responsible for safety of life at seas according to the 1948 London Convention, was first maritime authority to approve Nu-Swift 30 lb. Dry Powder Extinguisher, Model 1630, for use afloat. Approval is conditional upon spare charges also being carried.

43. SAS, SCANDINAVIAN AIR-LINES SYSTEM, justly renowned for service and efficiency, and 'First over the Pole' recently opened their new LONDON headquarters in fashionable Conduit Street. Nu-Swift protects the whole building, from which reservations all over the world can be made in a few minutes, before long further to be accelerated by the installation of electronic equipment.

44. Sir HUGH CASSON, famous British architect and exponent of MODERN DESIGN, is one of the many professional men whose premises are protected by Nu-Swift.

45. Rendezvous of the cosmopolitan smart set, the famous Palace Hotel, ST. MORITZ, Switzerland, near the Cresta Run, is now protected by Nu-Swift. So are many of the vessels of the rich GREEK SHIPOWNERS who make the Palace Hotel their winter headquarters.

46. Norwegian WHALE CATCHING SHIPS each year set out from SANDEFJORD, Norway, destined for hazardous adventures in ANTARCTICA. Six or nine months later they return after incredible hardship, but often with the pockets of the crew lined with gold. Most whalers and floating whale factories are equipped with reliable Nu-Swift.

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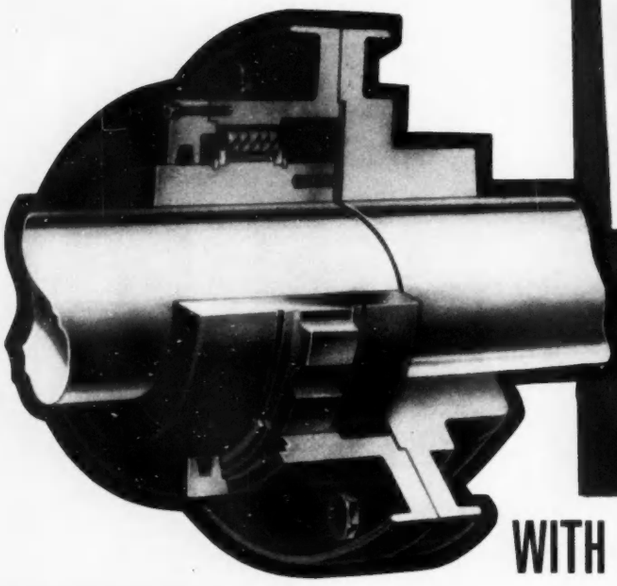

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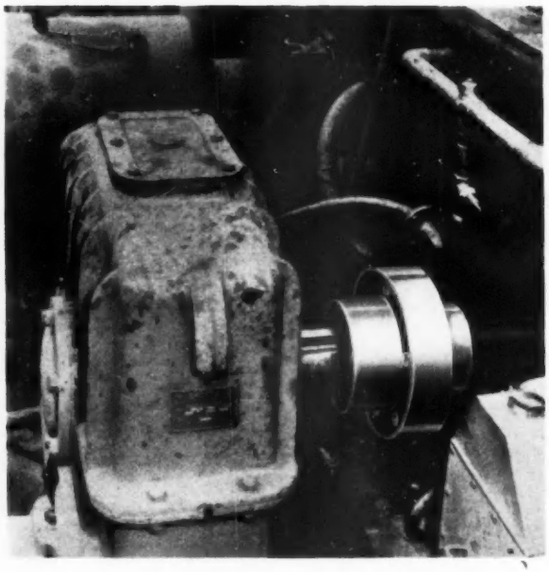

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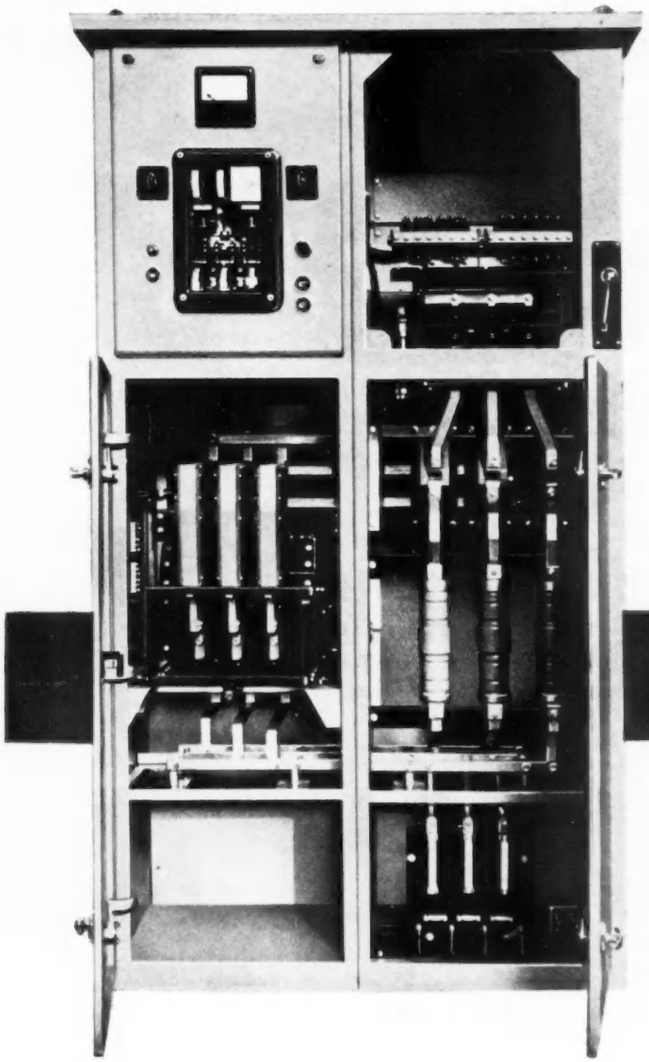
Rigorously tested in the Company's own research laboratory, the type K contactor starter is the latest product of the Belmos development team and continues the well-established Belmos tradition of good design and reliability. Suitable for the direct-on-line starting of 3·3 kV motors up to 600 h.p., it can be housed in a free-standing pillar or grouped with similar units to form a switchboard.



- ★ Air-break contactor rated at 150 amperes. Breaking capacity of 1,300 amperes at 3·3 kV, 0·25 power factor.
- ★ D.C. operating magnet supplied from 3,300/110 volt transformer within the pillar.
- ★ Reversing or Earthing isolator, mechanically and electrically interlocked, with 12 auxiliary switches, a.c. or d.c.
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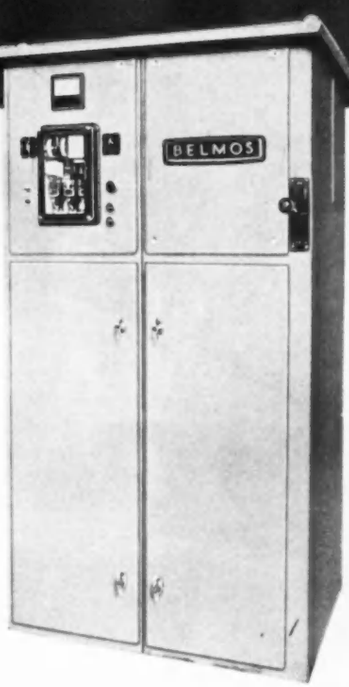
- ★ Optional earth leakage protection.
- ★ Comprehensive control arrangements, local and remote, with sequence interlocking and automatic sequence starting.
- ★ Provision for auxiliary services, such as brake protection, local lighting, etc.



the type K starter is fully described and illustrated in leaflet J240 which is available on request.

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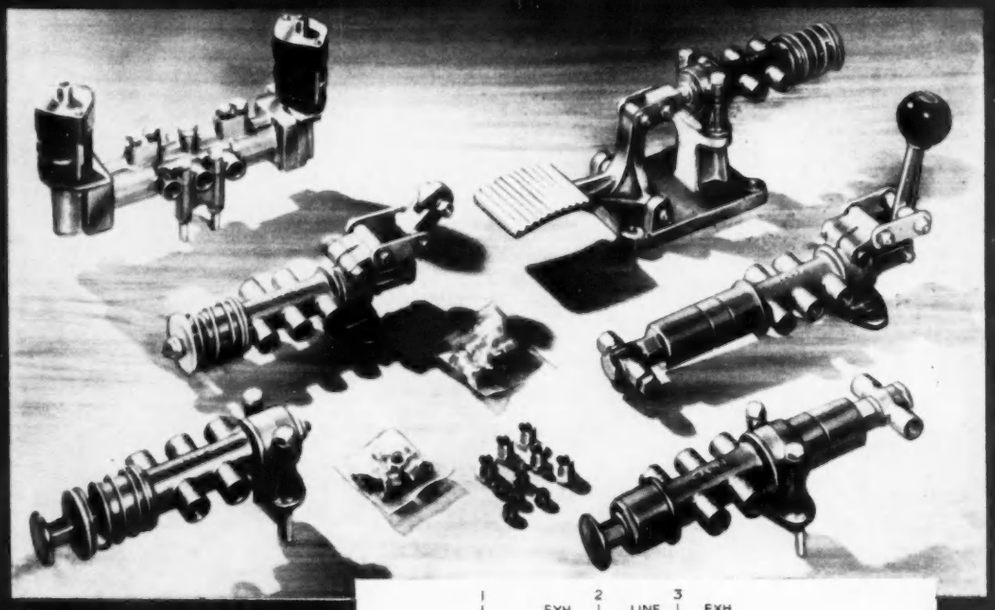

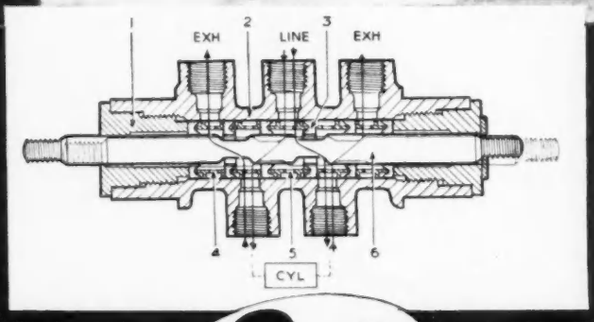

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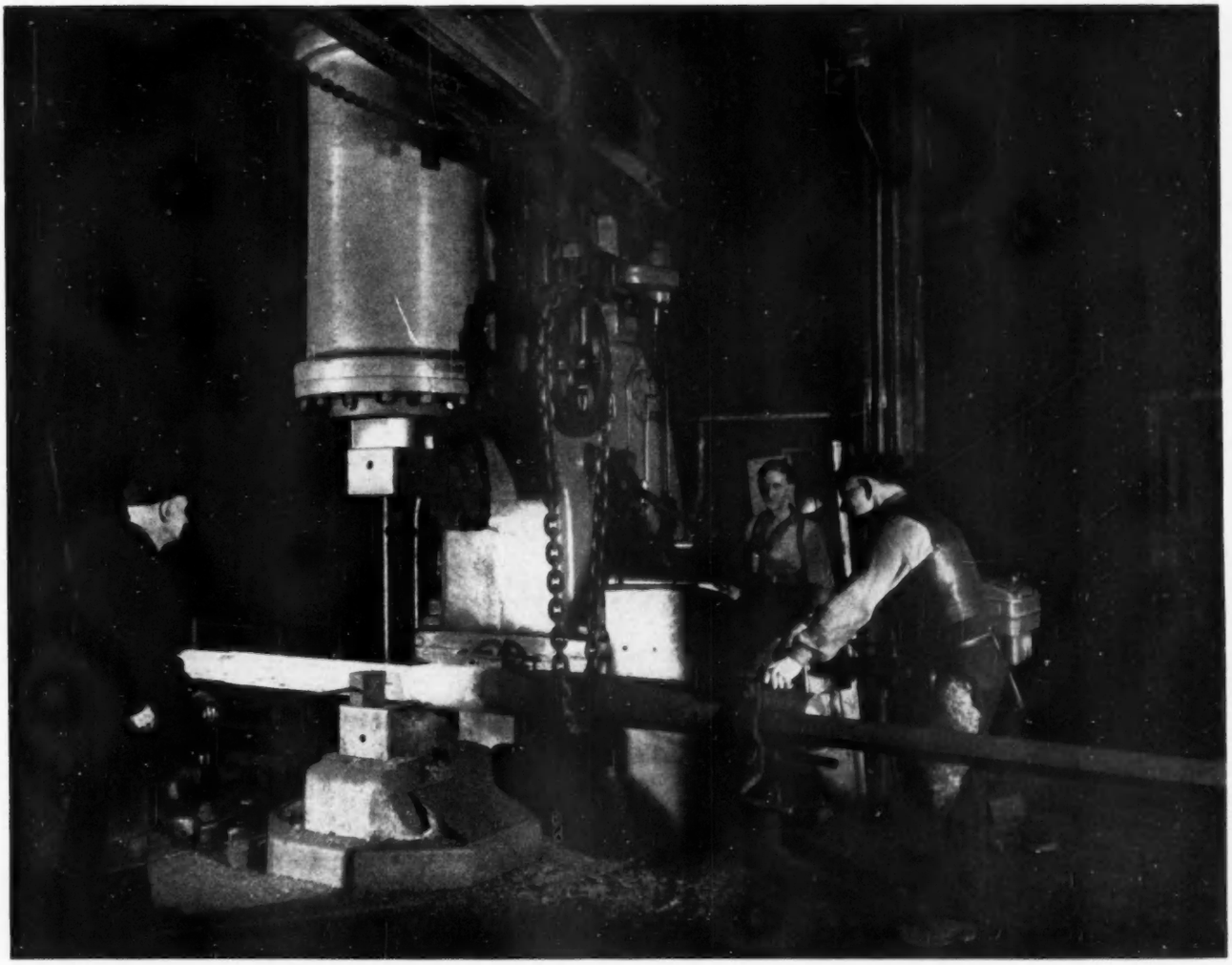

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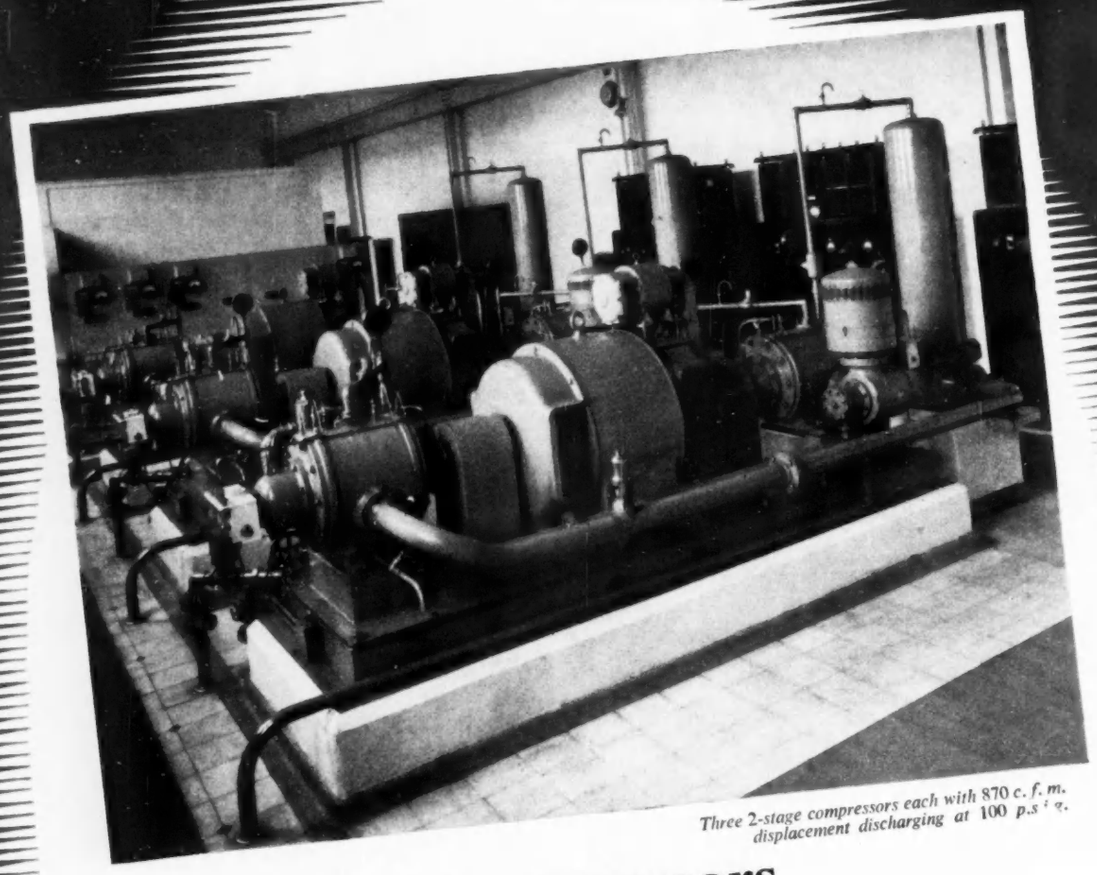

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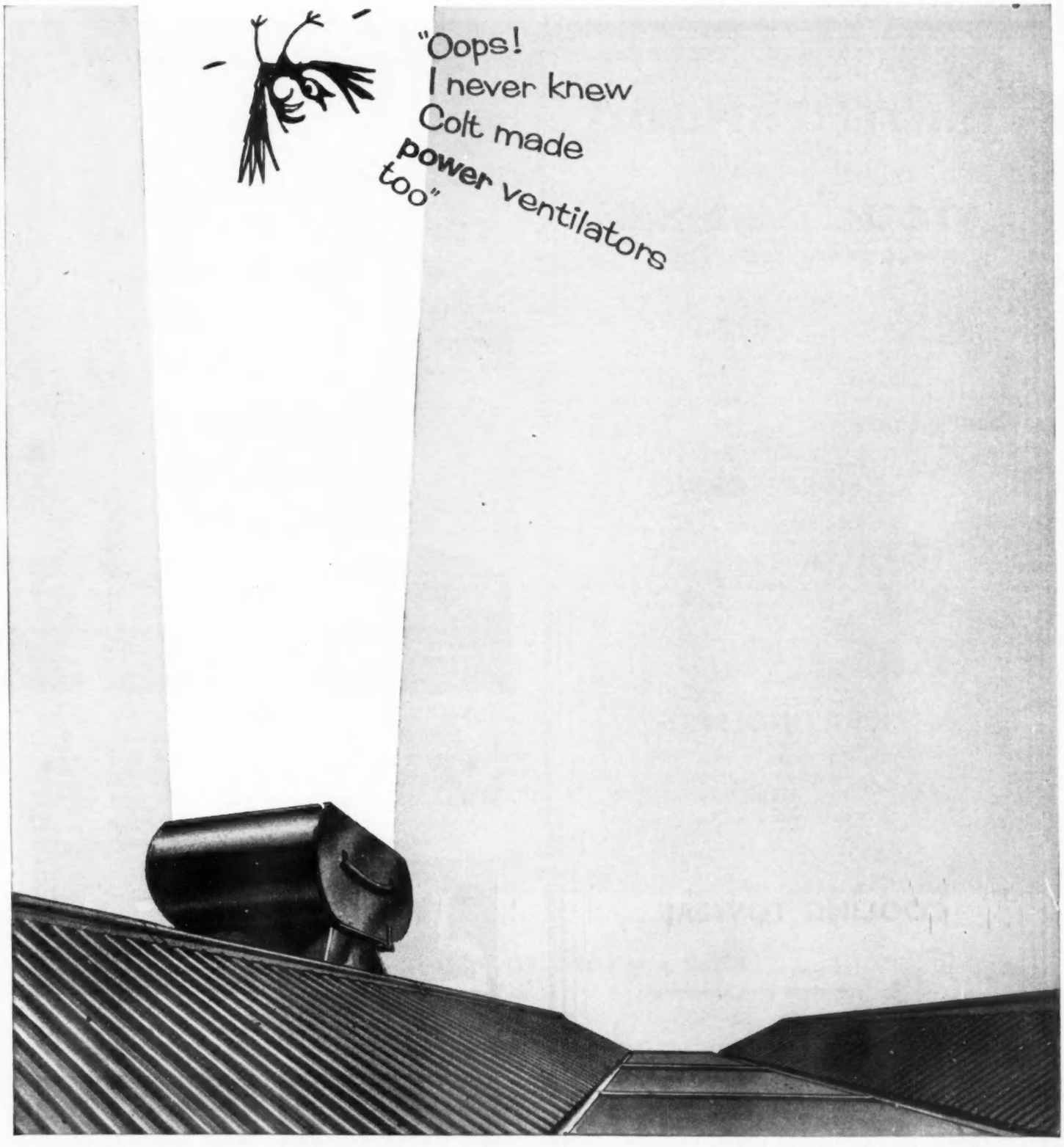

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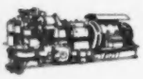

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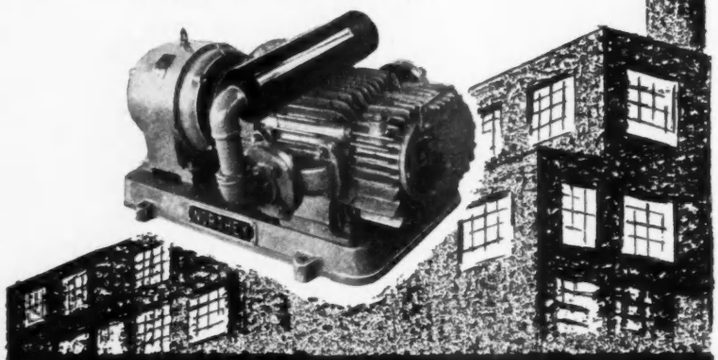

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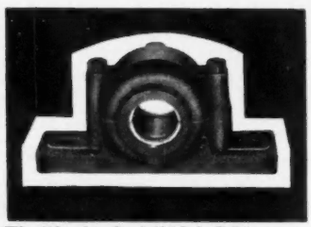
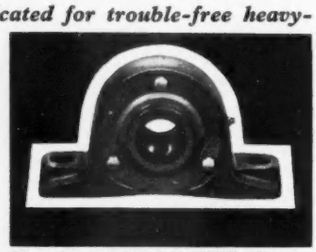
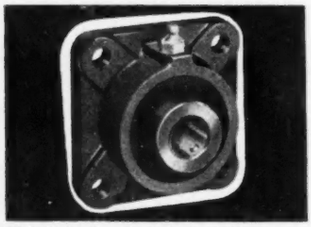


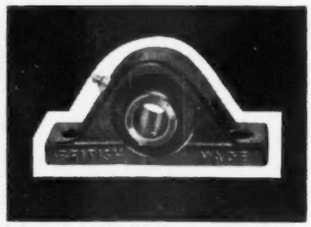
The "Auchterlonie" M.A.C. Plummer Block is fitted with double-row self-aligning adapter ball bearings.



The "Auchterlonie" WEB Pattern Plummer Block has standard double-row self-aligning ball bearings and is fitted with either Cork sealing washers or synthetic Rubber oil seals.



This "Auchterlonie" M.A.C. Flange Unit is a noteworthy advance in design. It is easily mounted, completely sealed to retain lubricant and exclude dust, and incorporates standard double-row, self-aligning ball bearings.



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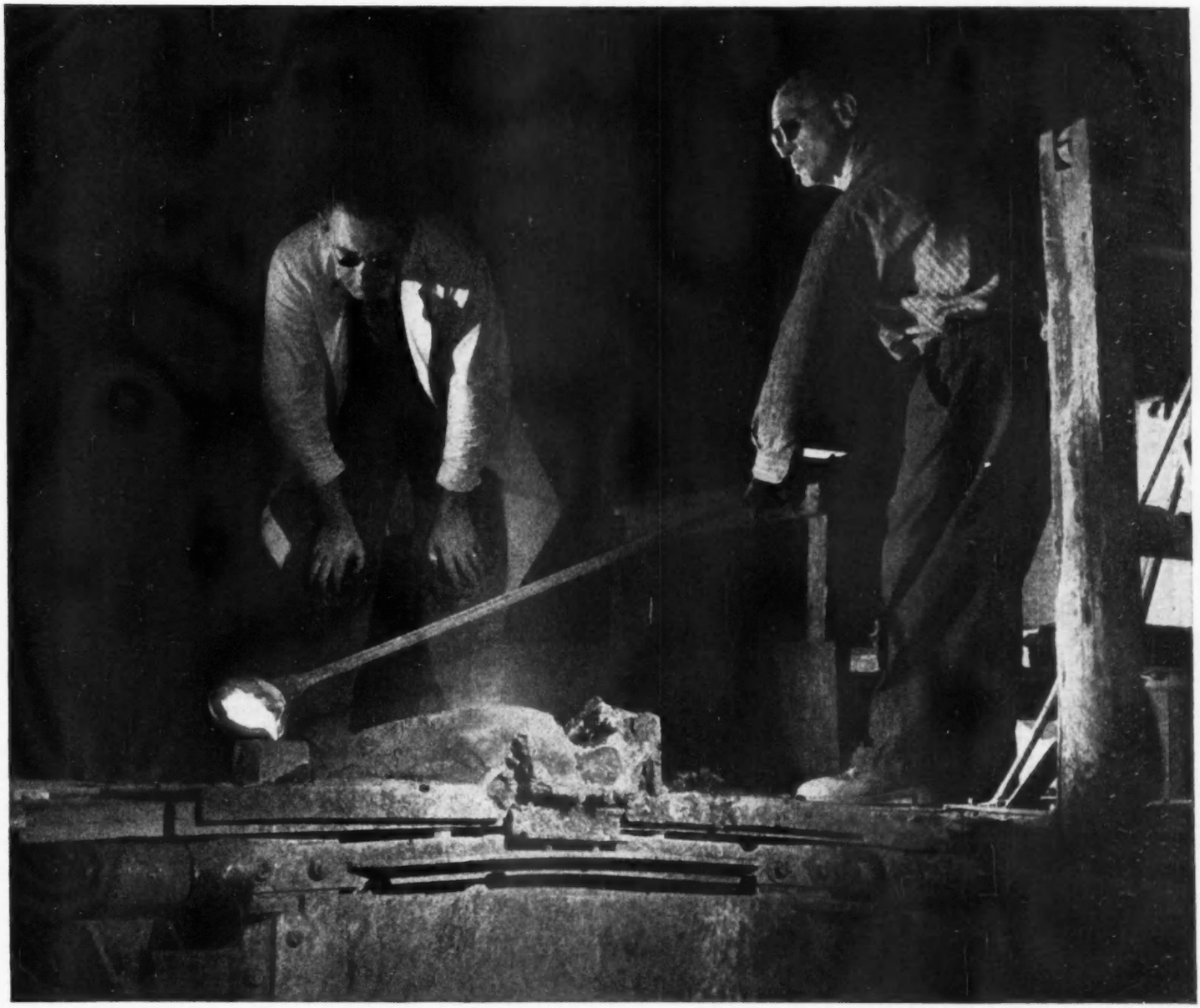

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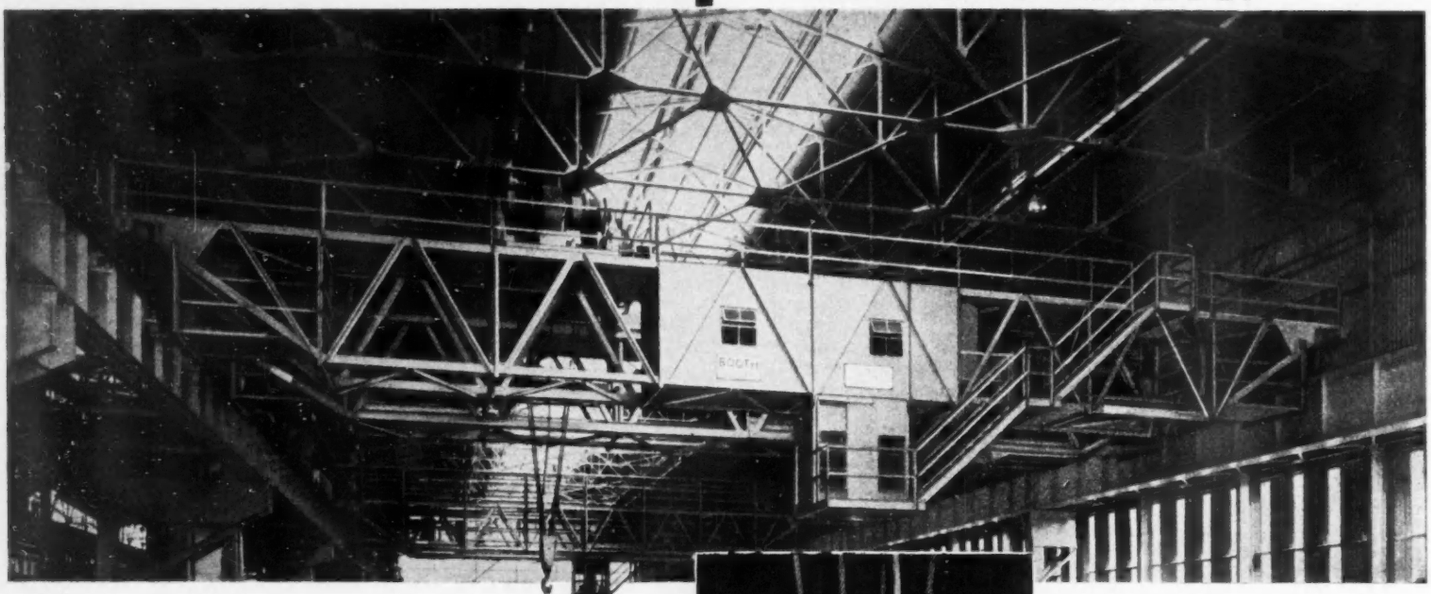
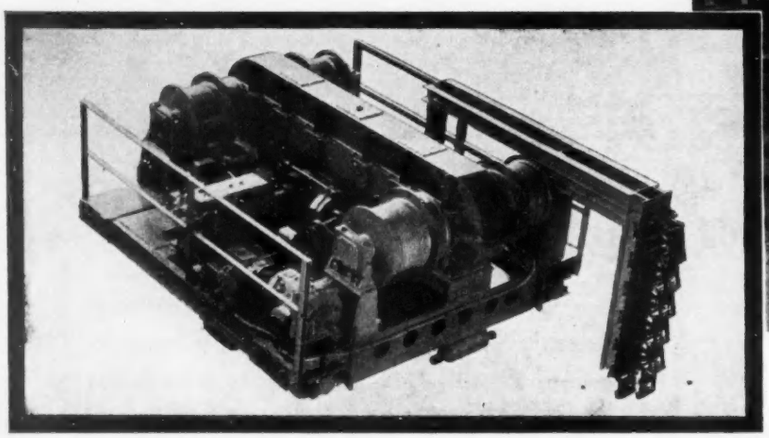


(ABOVE) Clyde-Booth four point suspension electric overhead travelling magnet crane at Messrs. Colvilles Ltd., Ravenscraig Works.
(RIGHT) The hook with slip-ring gear for the magnet, showing attachment of the four ropes.
(BELOW) The special four barrel crab.



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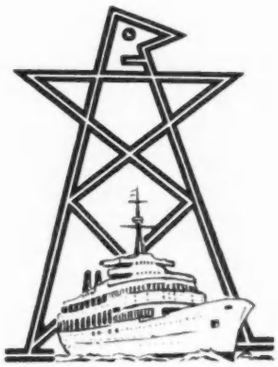

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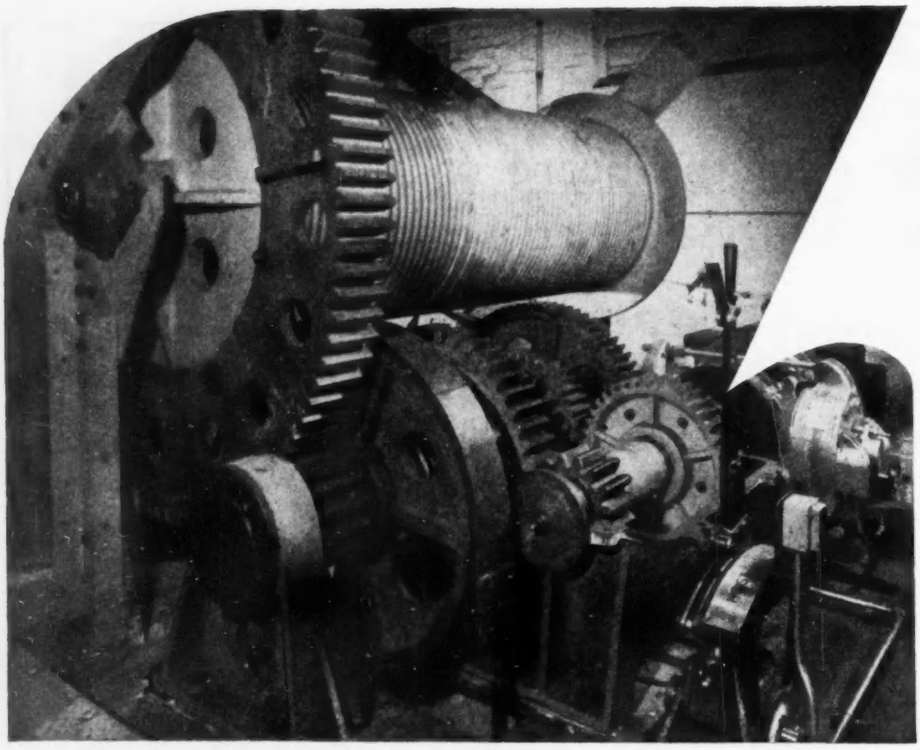

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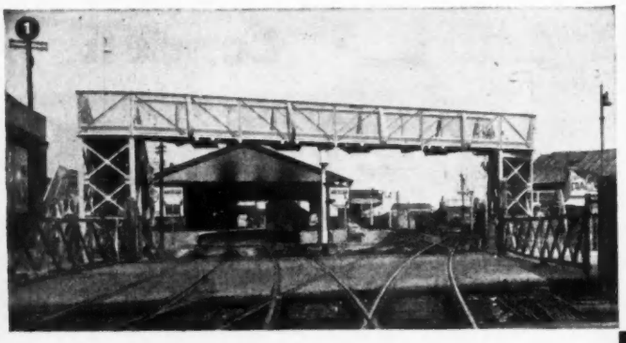
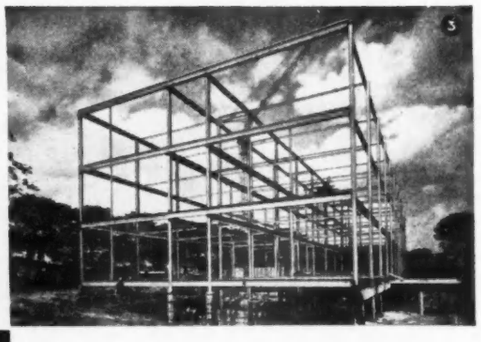


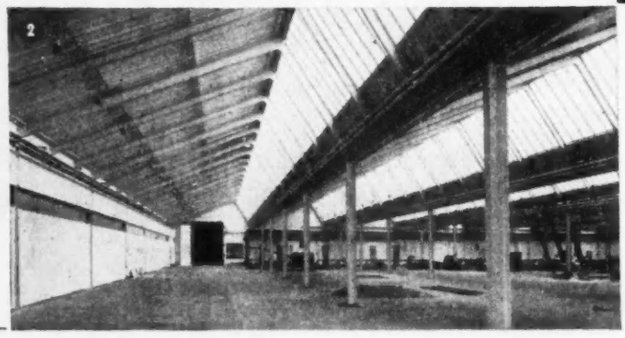
❶ Footbridge for Level Crossing in Grimsby.

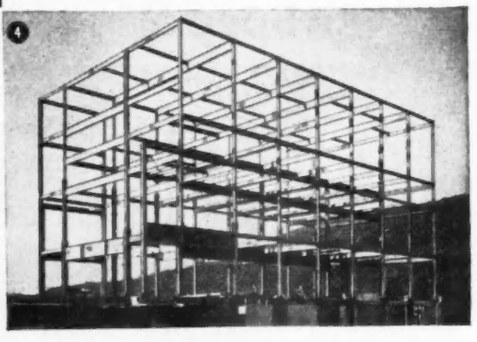
❷ Interior view of factory for Messrs. Brook Motors Ltd., Barnsley.



❸ Sowerby Bridge Secondary School.

❹ Control Room, Services and Welfare Block, Elland Power Station.





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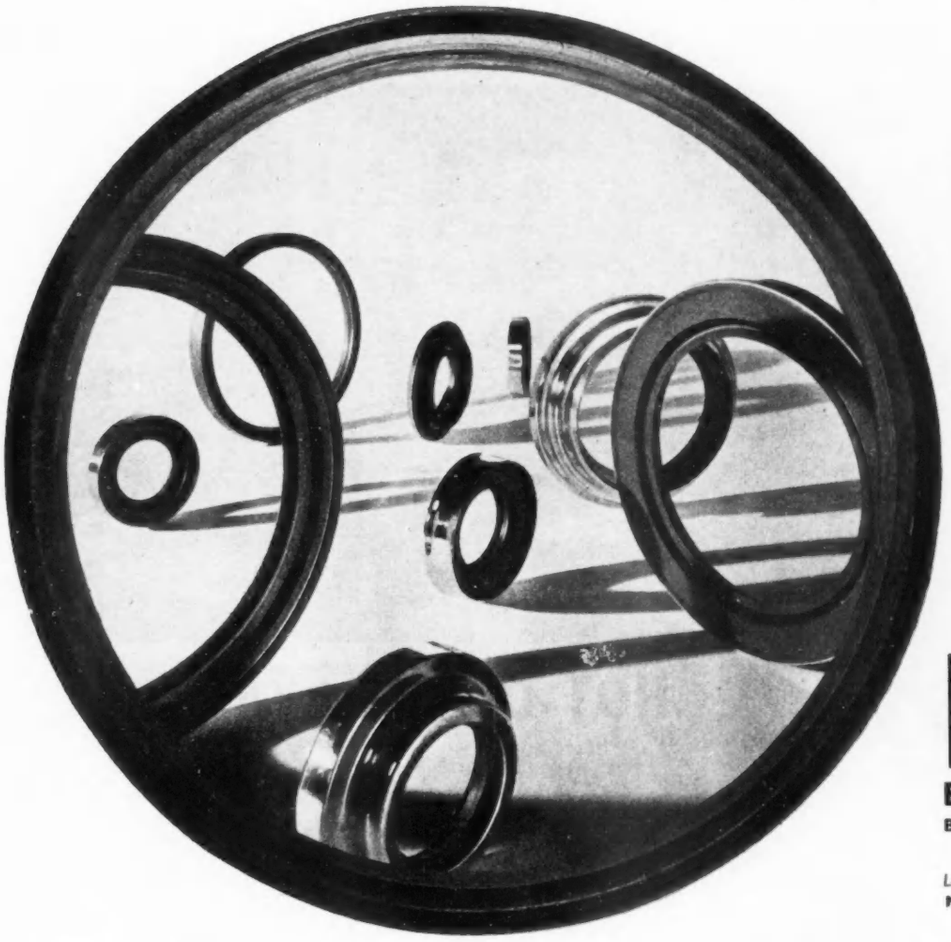

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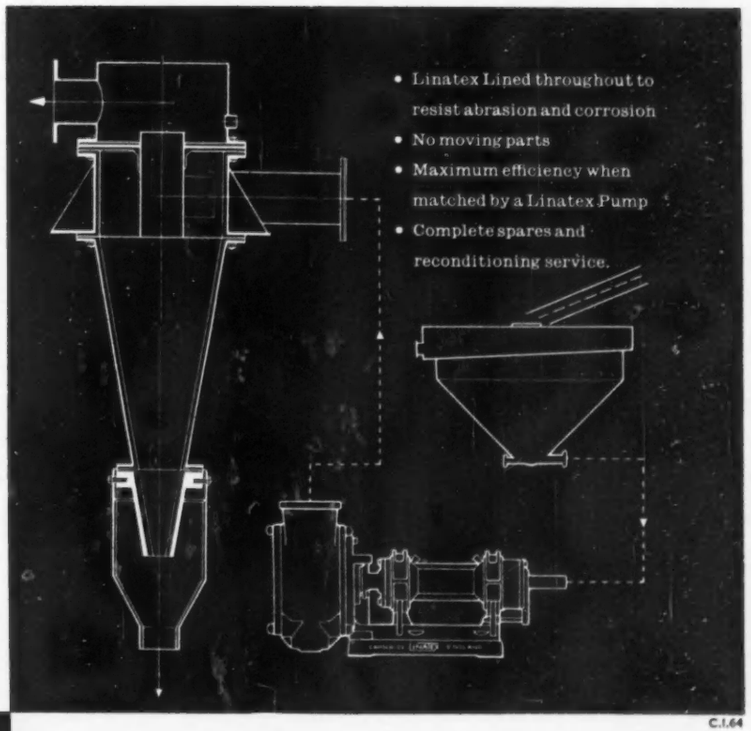
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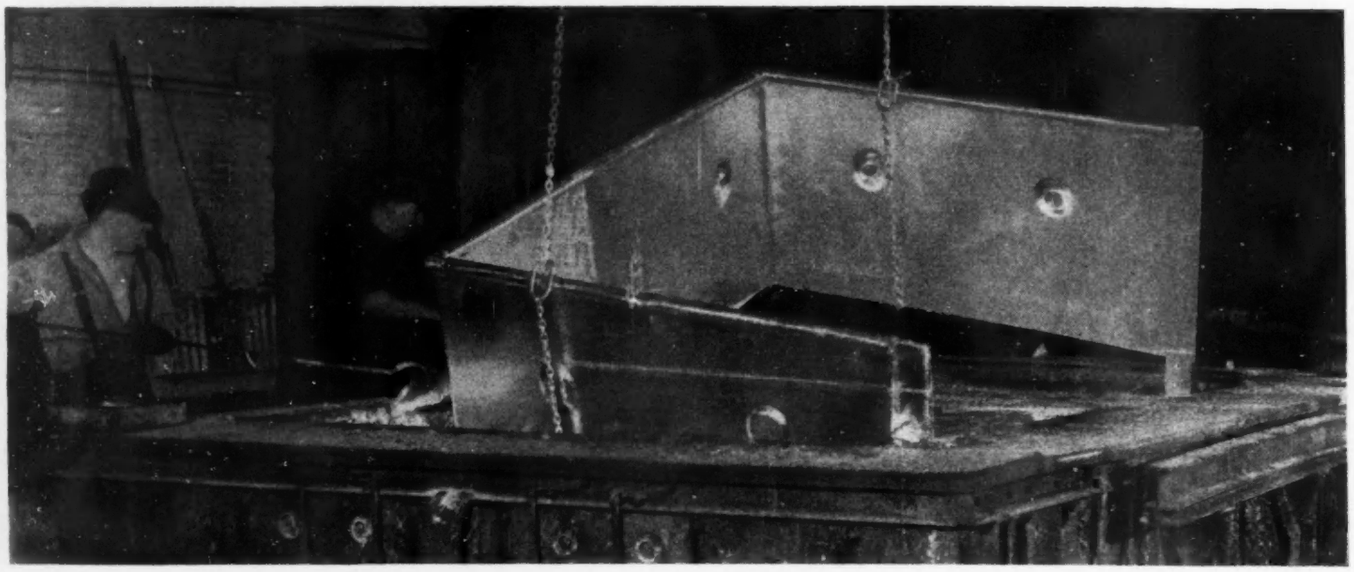

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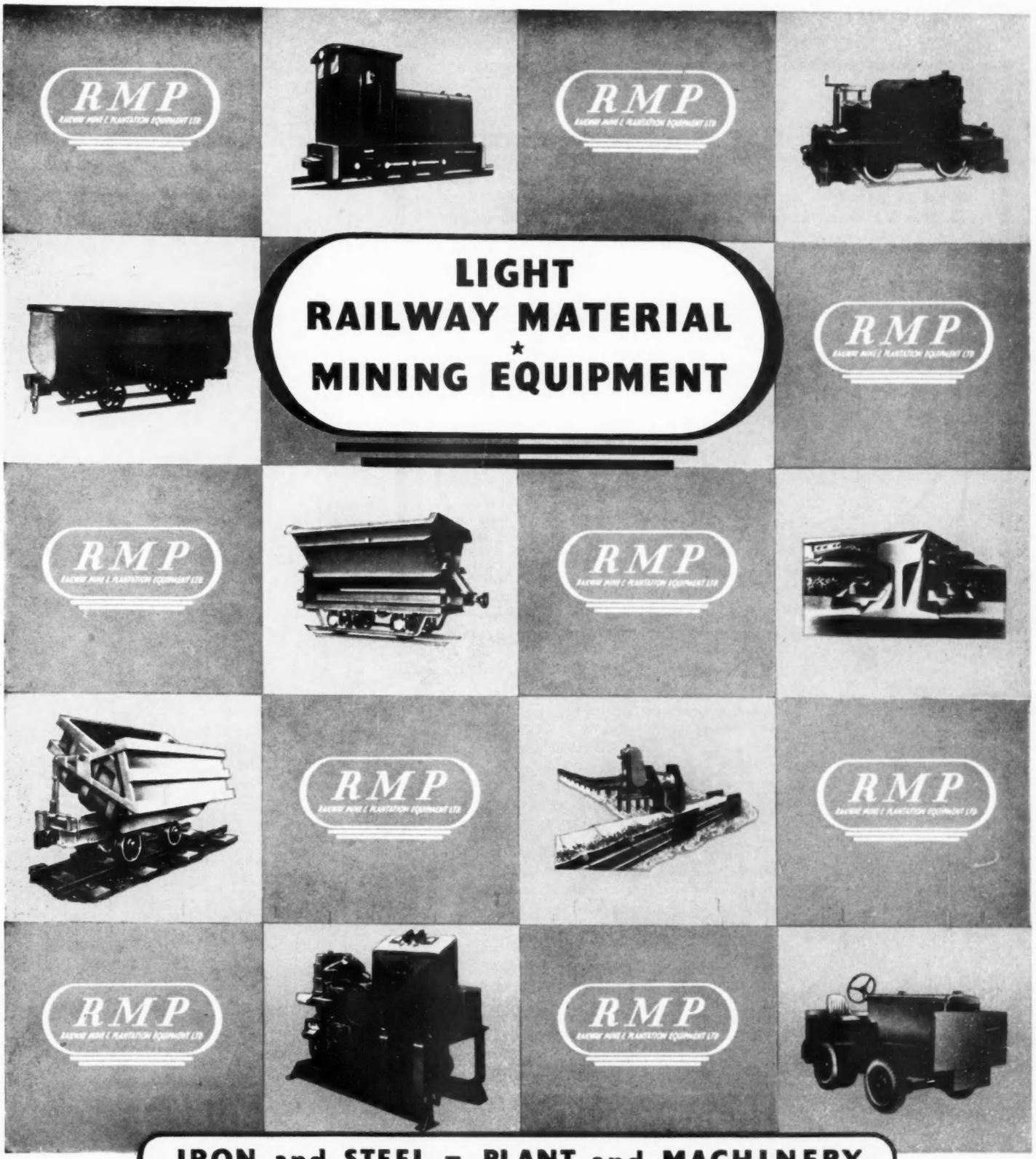

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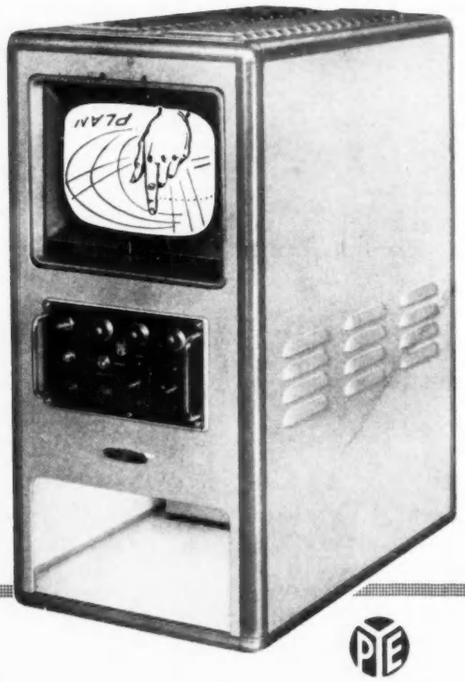

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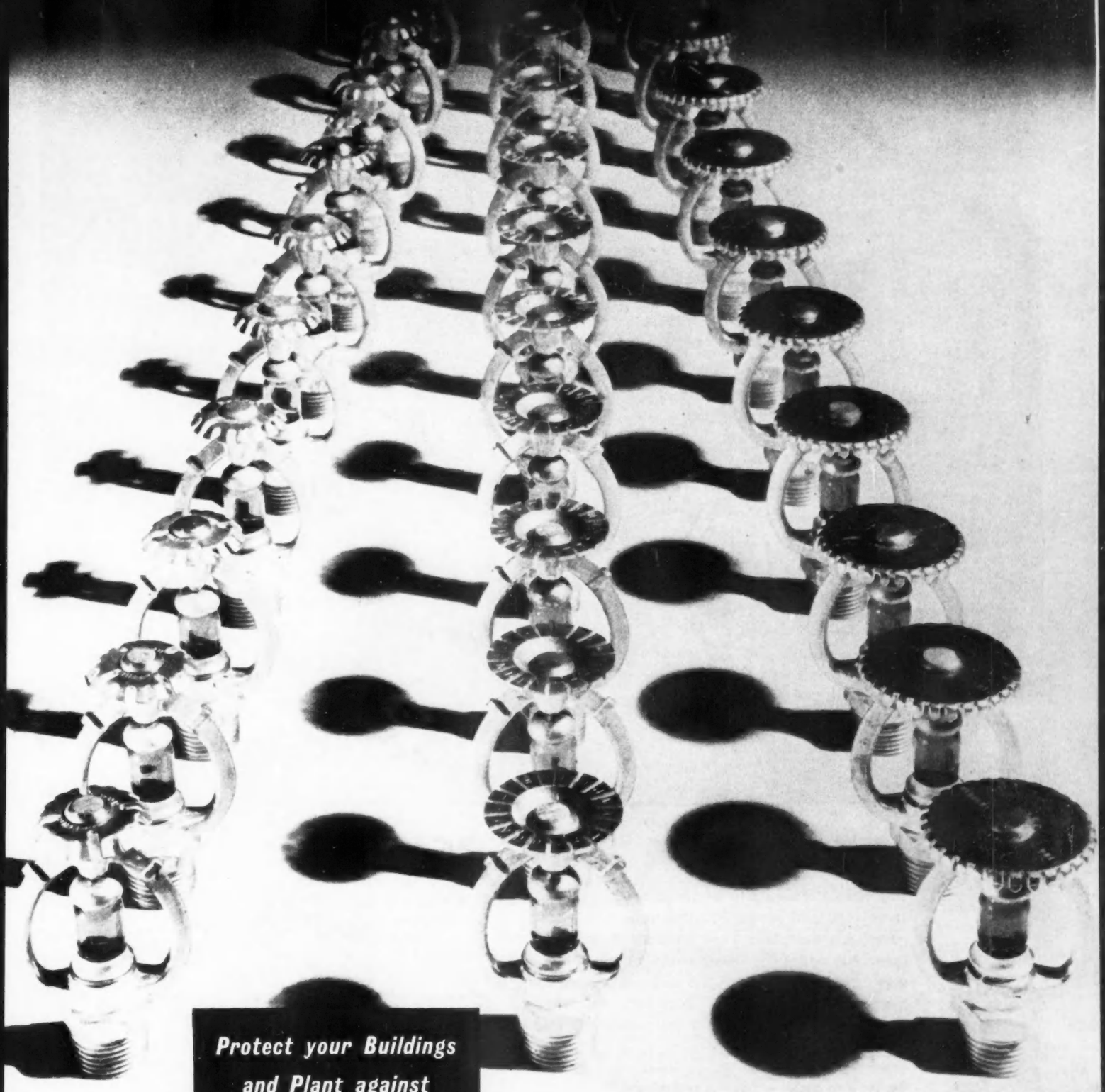

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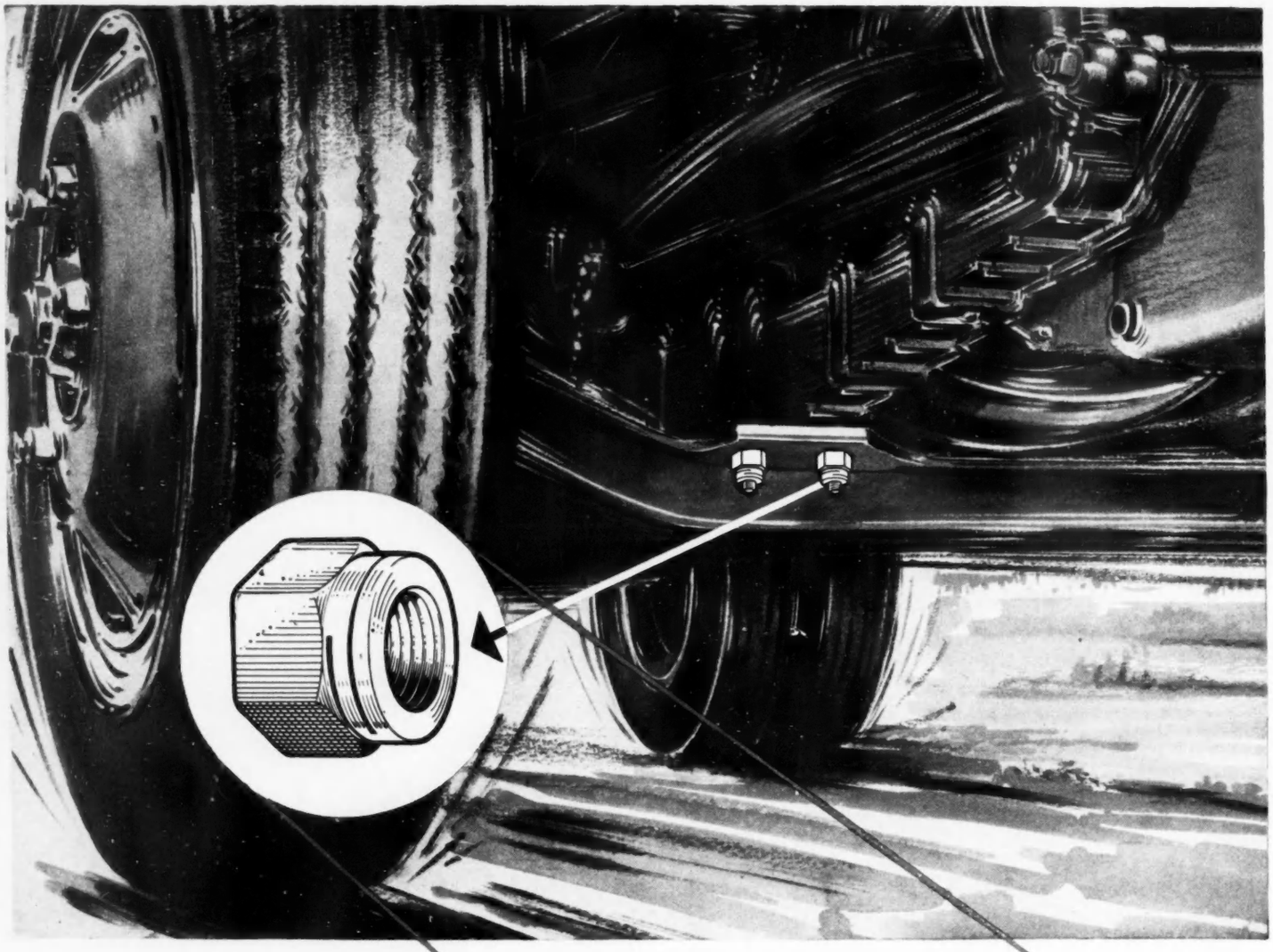

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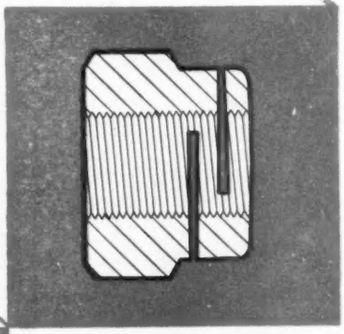

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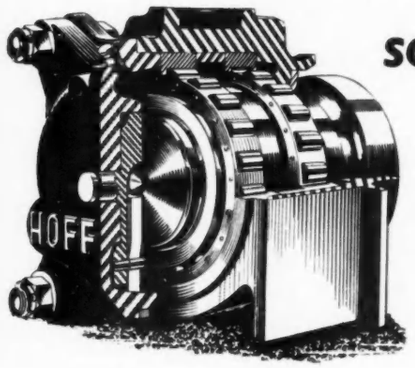

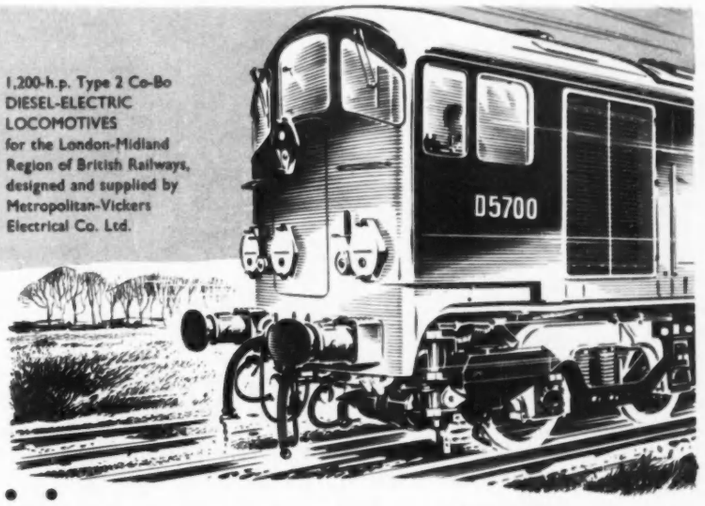

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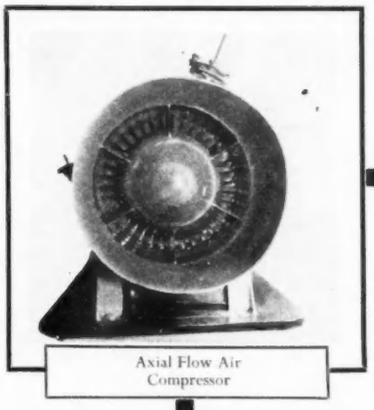
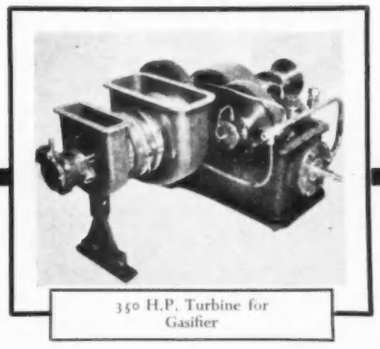
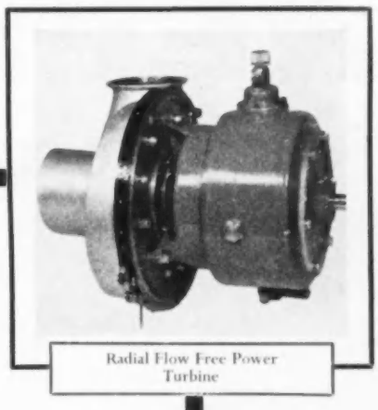


Axial Flow Air Compressor



350 H.P. Turbine for Gasifier



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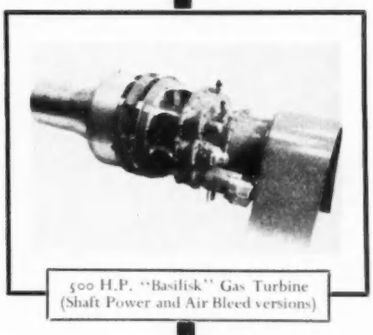

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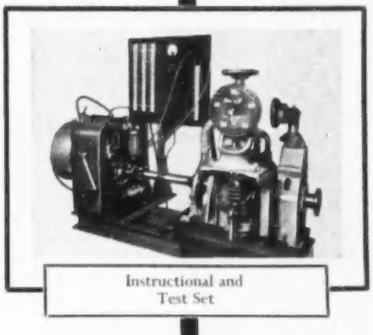

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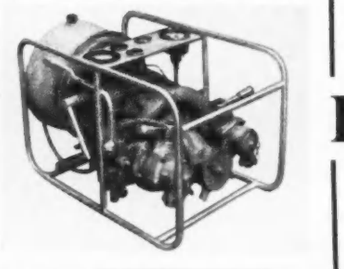

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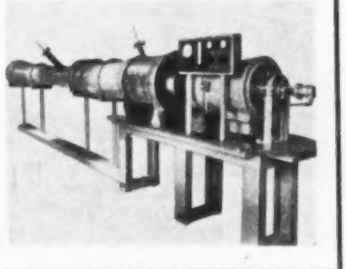

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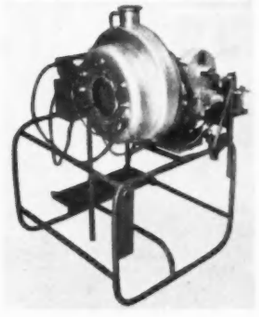

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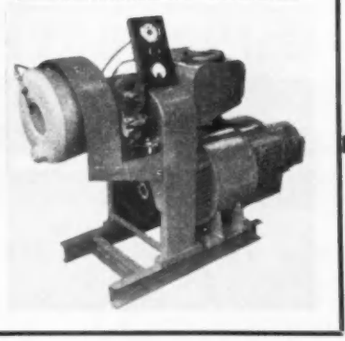

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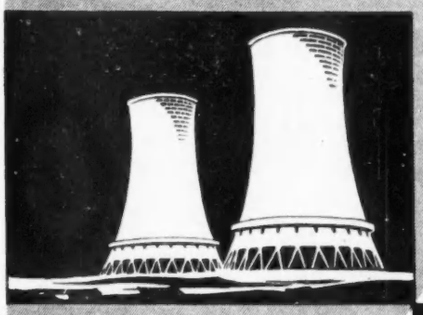

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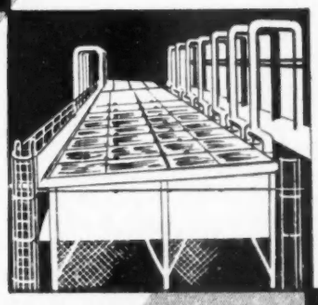

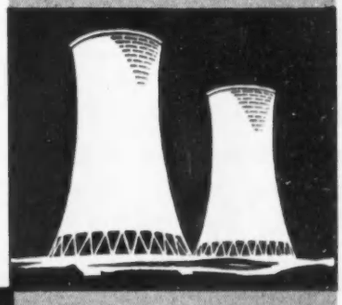

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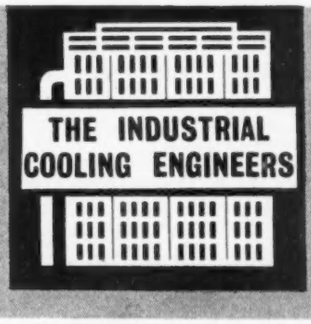

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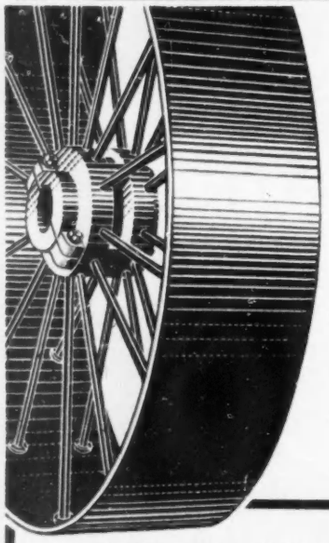

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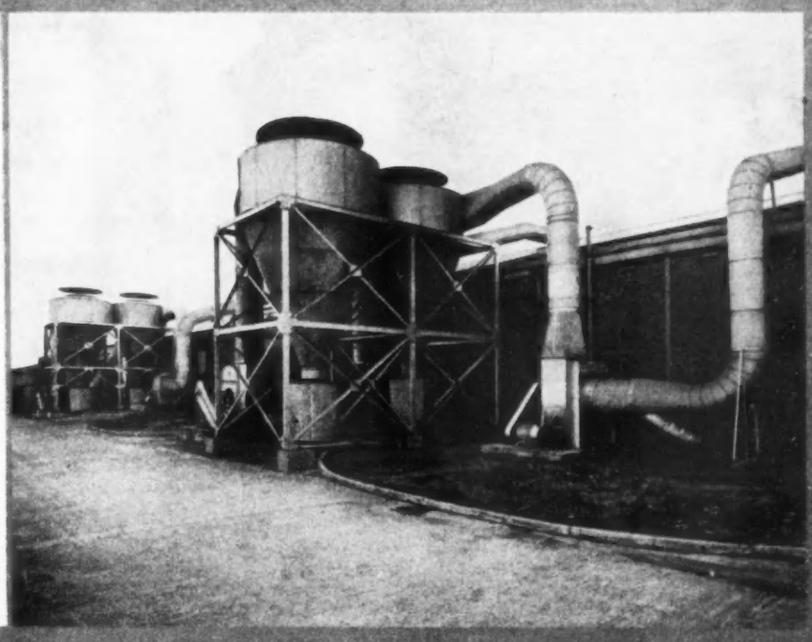

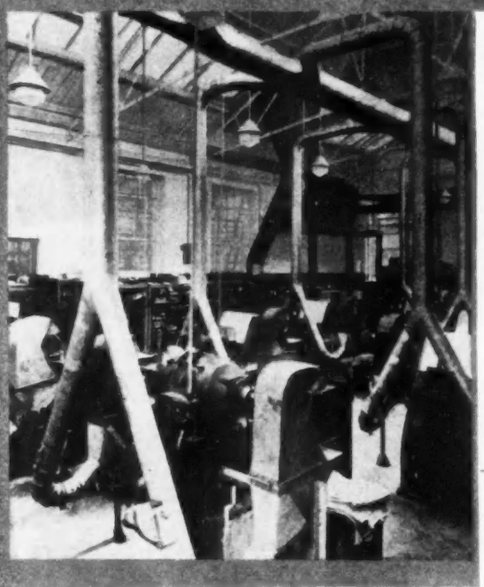

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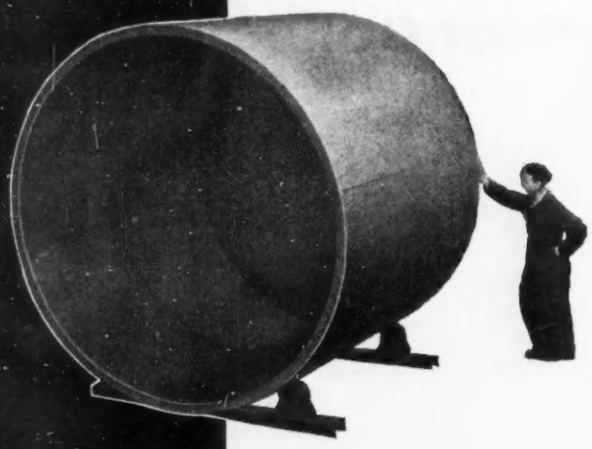

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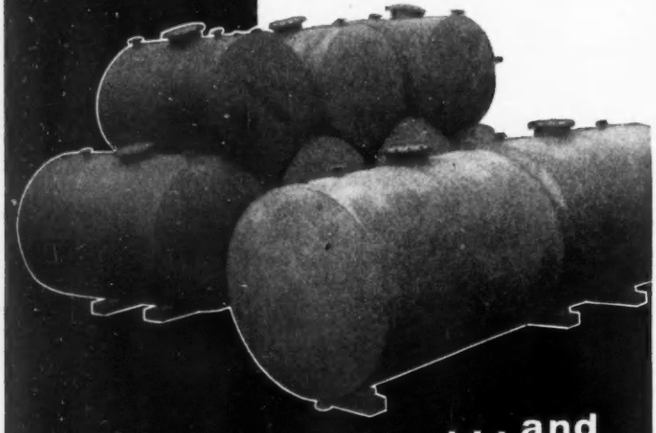

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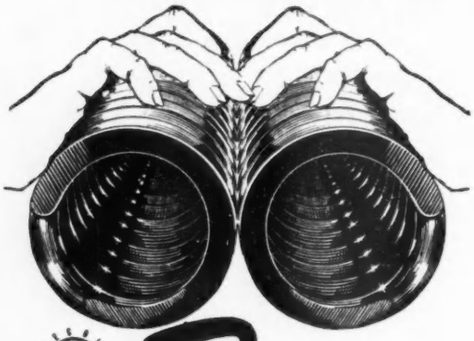

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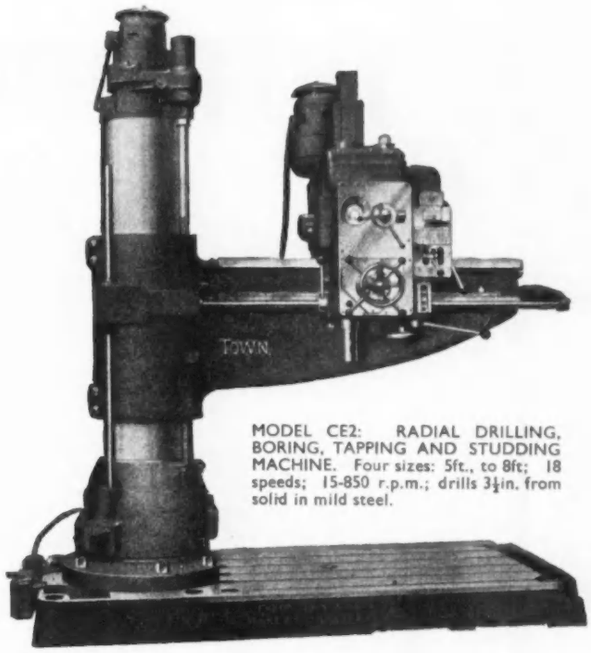
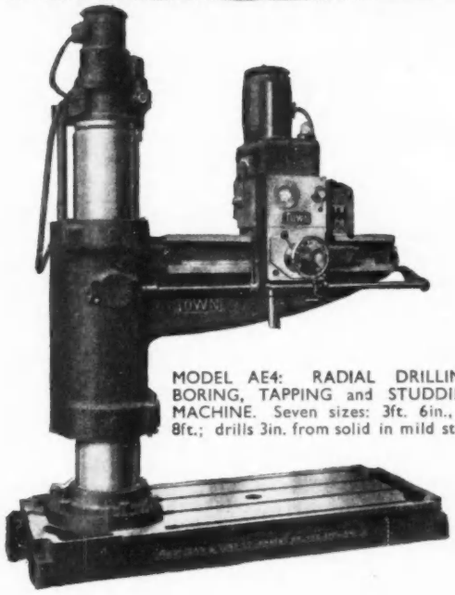
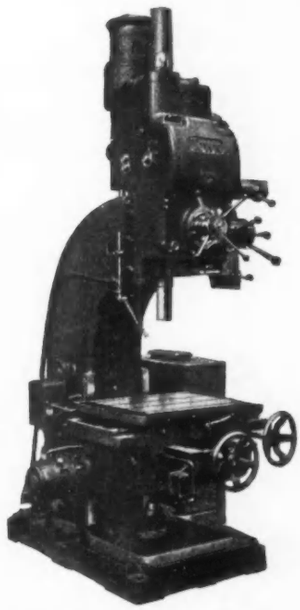


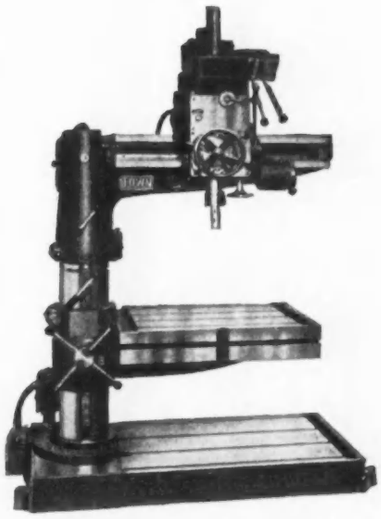
MODEL CE2: RADIAL DRILLING, BORING, TAPPING AND STUDDING MACHINE. Four sizes: 5ft., to 8ft; 18 speeds; 15-850 r.p.m.; drills 3¼in. from solid in mild steel.



MODEL AE4: RADIAL DRILLING, BORING, TAPPING and STUDDING MACHINE. Seven sizes: 3ft. 6in., to 8ft.; drills 3in. from solid in mild steel.



MODEL AE2: VERTICAL DRILLING MACHINE (Heavy duty model). Two sizes: 36in. and 42in.; drills 3¼in. from solid in mild steel.



MODEL AE5: RADIAL DRILLING, TAPPING and STUDDING MACHINE. 42in.; drills 1¼in. from solid in mild steel or 1½in. in cast iron.

MODELS EG4 and EG8 RADIAL DRILLING MACHINES. Each model in five sizes: 4ft., to 8ft.; 4 speeds; 160-600 r.p.m. (EG4), 8 speeds; 20-500 r.p.m. (EG8); drills up to 2in. from solid in mild steel. Also made with single speed.

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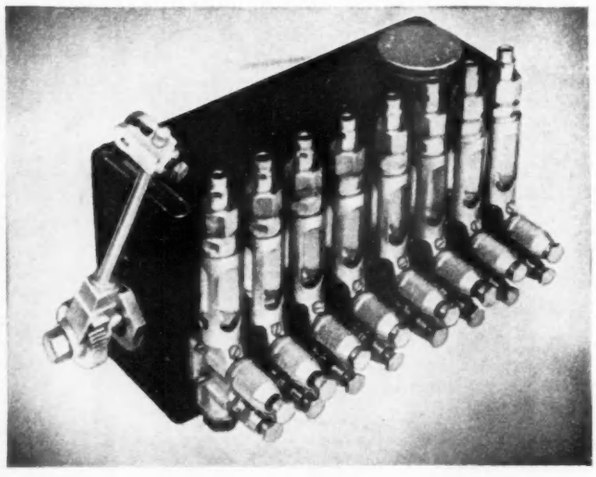

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ENGINEERING Impact

of Depreciation and the Budget

Among all the delegations and proposals that beset the Chancellor of the Exchequer over a longer and longer period before the Budget, one of the most reasonable this year is the machine tool trade's suggestion that companies be freed to fix the time in which their machine tools are depreciated and replaced.

At present there is a fixed annual percentage which can be written off plant values each year and this patently makes no differentiation between the manufacturer in a hurry to come up to date and the man who is content to take it easy.

The British Association of Machine Tool Merchants are able to quote no less an authority than Lord Piercy, the chairman of the Industrial and Commercial Finance Corporation, in their letter to Mr. Heathcoat Amory. Advocating greater investment in manufacturing industry, Lord Piercy had said that any temporary loss of income to the Treasury from industrialists writing off machinery as quickly as they chose would rapidly return to the Exchequer from the higher productive efficiency that would follow.

The Association has also asked the Chancellor to apply the Investment Allowance to properly overhauled and rebuilt used machine tools which are coming more into demand as delivery dates for new equipment lengthen again.

The Chancellor has lately thought it necessary to weigh in against inflation with a 5 per cent Bank rate. Some of the ill effects upon the engineering industries producing capital equipment would be removed, without putting money into the hands of the consumer, if the BAMTM's proposal were to be followed.

Order Books in Engineering and Shipbuilding

The first rise in the total value of the order books for the engineering and electrical goods industries after its long slack spell appears in the Board of Trade's estimate for November.

Taking January, 1958, as 100 the Index figure for November is 89, after standing at 88 for the greater part of last summer. Since the overseas orders had been picking up from much earlier in the year the increase is presumably reflecting a rise in the level of home orders.

As has already been observed, a much larger increase in deliveries, not accountable to moving stocks, took place in September and October.

Although the last quarter of 1959 brought British shipyards orders for 69 ships adding up to 172,000 tons gross, the overall picture for the year is not so good. The total of new orders for the whole year was 198 ships of 319,000 tons gross. While this tiny figure is down by more than a third from 1958's 497,000 gross tons, it is in fact an improvement since 288,000 of the 1958 total came from tankers whose contracts had been announced years before but on which final details had not been completed.

British shipyard orders have fallen to their present parlous state within three years of the 2,328,000 tons gross ordered in 1956. The position of the total order book is not as bad, though at the present rate of ordering it must continue to decline. The total orders with the yards have fallen from 6,828,000 tons gross at the end of 1957 to 4,169,000 tons gross at the end of last year. More than two million of that is of ships not yet laid down, many of them postponed until there is an improvement in the freight prospects.

Another Secret Machine Tool Report ?

What is wanted in the machine tool industry is not so much yet another report as that the results of any study that is made shall be published.

But the announcement of the sub-committee to examine methods of machine tool production carries no assurance that this will be so. If anything the reverse. When Mr. John Rodgers, Parliamentary Secretary at the Board of Trade, announced the new sub-committee's terms of reference in the House of Commons he was asked to give an undertaking that the report would be published. His highly unassuring reply was that the proceedings and reports of the Machine Tool Advisory Council, to whom the sub-committee will report, are confidential in order that members can express themselves frankly. He did say that there will be some form of public statement on the sub-committee's findings.

Since evidence and findings are easily distinguished, Mr. Rodgers's point would equally have been met by reservations on the evidence leaving room for an assurance on the findings.

The chairman of the sub-committee is to be Sir Steuart Mitchell, who is Controller of Guided Weapons and Electronics at the Ministry of Aviation. His committee's reference is:

> To consider the report by Professor Melman and to report what action can usefully be taken by the United Kingdom machine tool industry on his recommendations.

Mr. Gaitskell, the Labour Party's leader, said in the course of the exchanges in the House that failure to publish a report could only create the worst suspicions "that something is seriously wrong." The unpublished report is that on the industry by the Department of Scientific and Industrial Research.

Labour Groups Briefed

Shortly before the announcement of the Mitchell committee Mr. Austen Albu, a Labour M.P. of wide experience in industry, briefed members of the Party's economic and trade union groups with a memorandum on the machine tool trade's situation. He shows how the only slightly fluctuating British share of world exports of machine tools, from 14·6 per cent in 1953, up to 15·8 in 1955, down again to 14·2 per cent in 1958, compares poorly with the rise of Western Germany from 23·8 per cent in 1953 to 31·9 in 1958.

Suggesting a four point scheme, Mr. Albu advocated setting up a central research organisation and carrying out full market and product research; carrying out machine tool research and giving such contracts to "some of the better firms"; establishing a small scale prototype manufacturing unit; and, fourthly, creating a marketing branch to sell the results of this reasearch at home and abroad.

At first sight such a scheme has the advantage of building one stage out of the preceding step and it does not look expensive. Even if it were, Mr. Albu advocates government investment in the industry. What is much less controversial is that from Czechoslovakia, West Germany, Switzerland and perhaps from Russia competition will soon be hotter than ever before.

The Machine Tool Industry Replies

What it regards as unjustified public comment is alleged by the Machine Tools Trade Association to be causing considerable harm to its export possibilities. The MTTA has issued a statement dealing in detail with the three reports whose non-publication, the Association says, has been used to suggest that there is a sad state of affairs in the industry.

On the Department of Scientific and Industrial Research "paper," the MTTA explains that this was drawn up with full cooperation from machine tool firms. Many companies gave confidential information. If this were published, especially abroad, it would be to the obvious disadvantage of those firms.

This report is not simply the description, caustic or otherwise, of the industry, and now pigeon holed, that has been implied. Discussion between the DSIR and the industry has been going on ever since it was compiled.

Regional meetings are being held this month to carry one stage further the proposals on research which the MTTA has put to its members.

On the Melman report the MTTA welcomes the setting up of a sub-committee of the Machine Tool Advisory Council to examine his findings. It points out that, so far its members know, Melman did not visit a single machine tool maker in the United Kingdom during his one-week visit to this country. The National Production Advisory Council for Industry report contains nothing which the MTTA has not already published. Pointing this out the Association observe that it is not up to them whether the Melman report, commissioned by the European Productivity Agency, or the NPACI reports are published.

Corrosion Science Society Founded

As more and more nations become industrialised and as the watch on costs in industry becomes increasingly strict corrosion develops into a subject on which many more people want the facts.

The Corrosion Science Society has now been founded bringing the former scattered discussions under many differing society and institute roofs within the leadership of one body.

Specialist meetings have been held before in Europe. In the United States there is the Gordon Conference organisation. The setting up of the new body in this country is welcome as likely to lead to valuable and more rapid developments.

The aims of the Corrosion Science Society are:

To promote the advance of corrosion science and its application to practical problems,

To organise meetings from person-to-person level up to international gatherings of qualified people active in corrosion and protective research and practice,

To cooperate with all other people and organisations interested in corrosion.

The new society's first meeting is to be held on 4 to 5 April this year at Battersea College of Technology, London, SW. Papers will be presented, and discussed on a number of subjects including stress corrosion cracking, corrosion and protection of aluminium, cathodic protection, electrode processes and high temperature corrosion and oxidation. The honorary secretaries of the society are Dr. T. P. Hoar, Department of Metallurgy, Pembroke Street, Cambridge, and Dr. L. L. Shrier, Battersea College of Technology, London, SW11.

and Bogie Change at Brest-Litovsk

One of the less political differences between the British and the Russians is that the railways are a different gauge. While the British Transport Commission's stock, and most of the rest of Europe's rolls on a gauge of 4 ft 8½ in, the Russian Government's stock moves on broader gauge—5 ft.

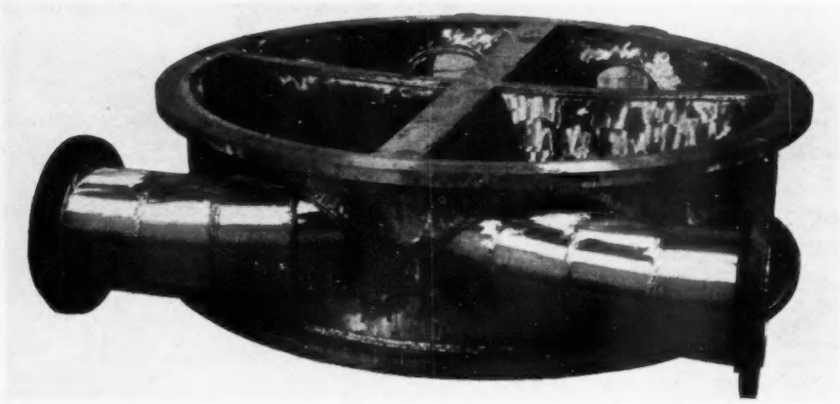
But just as the Spanish, who also have broader gauge (5 ft 5⅛ in), now have a private company with a fleet of wagons with axles that are changed at the Franco-Spanish border, so arrangements are being made that next year passengers will have through couchette accommodation from the Hook of Holland to Moscow, bogies being changed at Brest-Litovsk.

Sir Brian Robertson, the British Transport Commission chairman, who looked forward to this development in his recent address to the members of Europe House, went beyond the usual general references to a possible future Channel Tunnel. He foresaw that if it comes about it will be no simple Anglo-French link. Almost at once will become an Anglo-European link bringing about serious replanning of the railway modernisation schemes of systems further afield than British Railways.

One of its implications that would require urgent answer would be the difference between customs formalities on both passengers and freight entering and leaving Britain. Already the Rome agreement has followed up the widespread simplification of movement within the Benelux states and to and from France with plans for almost pre-First World War freedom of travel in the Common Market. As Sir Brian pointed out it still takes longer to enter and much longer to leave the United Kingdom than it ever did before the First World War.

Success in Fabricating Aluminium-Bronze

The know-how for welding aluminium-bronze is gradually being acquired though there have been many difficulties to be overcome in the process.



Water box for heat exchanger made in Al-bronze with mild steel flanges.

Aluminium-bronzes enjoy an unrivalled reputation for their resistance to seawater at economic cost. There are, however, many alloys in this family and the problems of fabrication by welding are neither standard nor obvious.

W. P. Butterfield Limited, of Shipley, Yorkshire, were recently contracted to make water and return boxes from one of these alloys and the success of their techniques should encourage wider use. The fabrication shown in the illustration is for a tubular heat exchanger destined for an American oil refinery.

Corrosion resistance to seawater, chlorides and dilute sulphuric and hydrochloric acids results from formation of a tenacious alumina film on the surface which is continuous and self healing under most conditions. The single-phase alloys show attractive low temperature properties with impact values of 60 ft-lb maintained down to − 200° C. Alloys with a two-phase structure are formed practically when the aluminium content exceeds 8 per cent. These complex alloys, which often contain nickel in addition to aluminium and iron, have good impact strength at low temperatures (about 25 ft-lb) and retain properties up to 400° C with complete absence of scaling. A further characteristic is the high resistance they have to abrasion.

Existing applications in which resistance to corrosion is the prime consideration include pressure vessels, evaporators, heat exchangers and condenser tubes and tube plates, especially in use with sea water. In the oil industry, heat exchanger parts are frequently subjected to attack of sea water on one side and oil distillates, often acid-bearing, on the other. Where higher strength, together with resistance to corrosion is required, complex bronzes are favoured. They are also popular in marine engineering. Since the first propeller was specified for motor torpedo boats in the Second World War in Al-bronze, several alloys have been produced which are even stronger than the standard two-phase 9·5 Al-4·5 Ni-4·0 Fe-bronze. In these manganese replaces some of the nickel and iron. One of the latest is Novoston, a 12 Mn-7·5 Al-2·5 Fe-2·0 Ni-bronze, which has an ultimate tensile strength of 44 tons per sq. in, an elongation on 2 in of 25 per cent, and an Izod impact strength at room temperature of 30 ft-lb. Such alloys are also used for propeller shafts, pump parts, A-brackets, stern tube bearings and deck fittings.

Strength of the two-phase alloys is much greater than that of the one-phase ones and know-how is required for any of them. With the 7·5 Al-2·4 Fe-bronze designated ASTM B169 Alloy D which is the one used by Butterfield, the prime difficulty was in finding a filler rod to give good corrosion resistance, sound welds, and good tensile properties. This was solved in collaboration with N. C. Aston Limited of Huddersfield, who supplied both the Al-bronze plate and the satisfactory filler rod.

The one-phase alloys are readily produced in wire form by virtue of their excellent cold ductility, but one-phase weld metals are susceptible to hot cracking. Complex alloy wires are more difficult to produce due to their higher strength and lower cold ductility, but are reasonably free from weld cracking. Nartrode E, which turned out to be the most successful electrode for Butterfield, conforms to ASTM B171 Alloy E and is a 9·5 Al-5 Ni-3·5 Fe-bronze having a minimum ultimate tensile strength of 40 tons per sq. in and an elongation of 10 per cent minimum on 2 in.

Butterfield found the inert-gas metal-arc process the most successful and coupling this electrode with the base alloy, the weld strength proved to be 43 tons per sq. in ultimate, with a maximum elongation of 29 per cent on all-weld metal. An important factor in producing high quality welds was thorough cleanliness of the joint faces and of filler wire. The radiograph illustrated shows the gas porosity obtained with early runs using normally clean electrode wire. This was reduced only after the company arranged to have the wire chemically cleaned and cold drawn to a mirror finish.

The preparation of plates and sections for fabrication is achieved by shearing, friction bandsaw, and machining, the choice depending on plate thickness. Oxyacetylene flame cutting is not possible, but considerable success is being achieved with the tungsten arc cutting process.

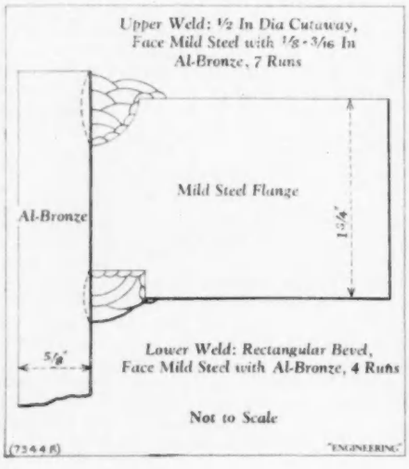
Typical plate preparation for butt welds of Al-bronze to itself in $\frac{5}{8}$ in plate proved to be welding from one side with a $\frac{3}{8}$ in deep bevel and $\frac{1}{16}$ in root face with no gap, followed by grinding back to give a $\frac{3}{8}$ in deep bevel to be filled from the second surface.

On the water boxes fabricated by Butterfield were several mild steel flanges put there to reduce cost in non-corrosive positions. Satisfactory welds were produced by precoating the mild steel with Al-bronze by inert-gas metal-arc welding, the filler rod being standard but the penetration being kept low. A current of 180A was typical for this job using $\frac{1}{8}$ in diameter filler wire, where 280-300A would have been employed for butt joints of Al-bronze to itself with the same wire. The mild steel had to be ground and sanded, rather than shotblasted, immediately prior to precoating. The welding procedure is shown in the diagram for one of the flanges. Preheating of the mild steel and Al-bronze to 100° C was found necessary.

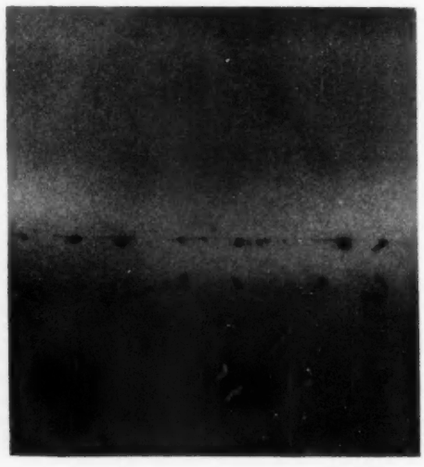
Butterfield describe the welding of this Al-bronze as straightforward, but their experience to date is on a maximum plate thickness of $\frac{5}{8}$ in requiring a maximum number of five runs one over the other. Another body is interested in this, however, namely British Welding Research Association. Their experience to date is that continuous heating and cooling can cause brittleness in multirun welds in such alloy, especially in plate over $\frac{1}{2}$ in thick. This is probably due to precipitation of bismuth, originally present in quantities less than 0·0005 per cent. They find that addition of lithium to the filler rod helps avoid this. Then with regard to corrosion resistance, they are working in collaboration with the British Non-Ferrous Metals Research Association with a range of filler rods, one-phase, two-phase, and those containing nickel and manganese. Dealumination in two-phase alloy welds is described as the *bête-noire* of Al-bronze and Butterfields recommend the nickel-containing alloy for this.

Certainly, the future of these alloys is made more rosy by the successful lead taken by Butterfield in fabricating these water boxes, but there are still some problems lurking in the background which need to be solved.

Weld preparation for Al-bronze to mild steel.

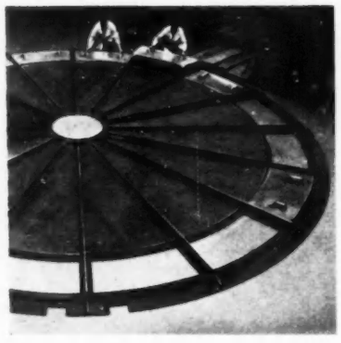

Upper Weld: ½ In Dia Cutaway, Face Mild Steel with 1/8 - 3/16 In Al-Bronze, 7 Runs
Mild Steel Flange
Al-Bronze
1 3/4"
5/8"
Lower Weld: Rectangular Bevel, Face Mild Steel with Al-Bronze, 4 Runs
Not to Scale
(7544 F)
"ENGINEERING"

Gas porosity in preliminary welds.



Plastic Covers Contain Acid Vapours

Solid resin reinforced covers, 30 ft in diameter, are being used on effluent settling tanks at the National Smelting Company's Swansea Vale works. Each of these covers is made in eight separate segments and is designed to withstand acidic vapour arising from sulphur dioxide saturated liquors containing traces of other acids.



Reinforced resin resists sulphurous fumes.

Around the perimeter of each cover are sixteen gas-tight inspection covers giving access to the clarified liquor overflow weir. Deposited sludge is removed by a Dorr thickener mechanism at the centre of the conical base.

Permali Limited, Bristol Road, Gloucester.

Don't Let Paint Stick on the Wall

Unless spray booths have side water walls as well as the normal rear water wall, it is virtually impossible to keep overspray from building up where it is not wanted. Even with semi-automatic spraying, when the amount of paint or sprayed material is carefully regulated to prevent wastage, some paint will adhere to the inside of the booth.

Now Aerostyle market a rubbery material called Stripcoat which can be sprayed or brushed on to the sheet metal work, laid on slightly more thickly than a normal coat of paint. When the booth is cleaned, all that is necessary is to scrape up one corner and strip off the coat which, in a matter of a few minutes, comes away in one piece comprising the overspray paint from many hours of booth operation.

Aerostyle Limited, Sunbeam Road, North Acton, London, NW10.

Polyester Film Heat Sealable and Metallised

Films made from the same basic material as Terylene fibres are very strong, 10,000 lb per sq. in being typical. Not only are they tough, but they have low permeability to both liquids and gases; in fact, they share most of the desirable properties of polyethylene, cellophane and pvc films with more thrown in. Chemical resistance to most inorganic liquids except alkalies is outstanding, films will stand up to boiling water and there are no additives (modifiers or extenders) to be leached out or which evaporate and cause brittleness.

Even in spite of higher cost then more common film such as polyethylene one would expect wide application for packaging of chemicals, paints, pigments, metal components such as bearings, detergents and such like. ICI, incidentally, foresee a large market and are going ahead with building commercial size plant in the United Kingdom. Their name for it is Melinex, Du Pont's in the USA is Mylar, and the Minnesota Mining version is called Scotchpak polyester film.

The films, however, have their difficulties and the one which has most held up exploitation is that of heat sealing. Polyesters are thermo-setting plastics which cannot easily be softened by heating—unlike polyethylene and other thermoplastic materials. Melinex can be heat sealed above 270° C but the joints are rather brittle. Hope is therefore seen in development of a heat sealable grade by Minnesota Mining. This joining property is obtained through chemical treatment of one or both surfaces but is claimed not to affect chemical resistance. Heat sealing at 200 to 250° C for 0·2-2·0 seconds under a pressure of 20 to 60 lb per sq. in yields a join which is tougher than the sheet material under any condition of stressing.

Vacuum coating of polyester films with metals like aluminium is even easier than with competitive films because of absence of volatile constituents. Permeability is decreased and reflectivity is high. Packaging is one outlet of such material but another interesting one is for reflectors.

Du Pont report that a new runway lighting system installed recently at Washington National Airport uses metallised Mylar film bonded to aluminium for reflectors. The aluminium had a clean mill finish before lamination. After this process any metalworking operations could be carried out. The polyester film with its good weatherability protects the reflector surface.

Minnesota Mining and Manufacturing Company Limited, 3M House, Wigmore Street, London, W1.
E.I. Du Pont de Nemours and Company, Wilmington 98, Delaware, USA.

Attractive Magnet Alloy

Alnica VIIA, a new permanent magnet material with an oriented energy value of $2{\cdot}8 \times 10^6$ gauss-oersteds, is now being produced for use in magnetic core meter and instrument applications by Indiana Steel Products Company in the USA. This material exhibits an extremely high coercive force, considerably higher than other materials in the Alnico family. For this reason it resists demagnetisation even when subjected to high environmental heat often associated with core meters. Studies to date indicate use in panel, and miniaturised meters. Applications involving limited magnetic length are also suggested. Alnico VIIA will be supplied oriented or non-oriented.

Auriema-Europe, SA, 27 Rue du Berger, Brussels, Belgium.

Equivalent Steel Specifications

It would be a great day if a book were published showing the equivalence of specifications for all alloys in the world. It would be just such an occasion for rejoicing if the specifications, even of ferrous metals alone, were capable of comparison. Any book which attempts to show the equivalence of alloys must now at least have in bold type the foreword "If information is required for contract or similar purposes, it is essential that the relevant specification current at the time should be consulted." Why does this appear? Because the methods of testing and the composition tolerances vary so much from country to country that it is only possible to give a superficial indication of where standards coincide which must be based on comparison of a selected property; carbon content for wrought steels, for instance.

Two new publications deserve comment, the first a British Standard "Comparison of British and Overseas Standards for Steels," BS 3179 : 1959, Part 1. "Chemical Composition of Wrought Carbon Steels: British Standard, SAE and DIN" (6*s*); the second is a new BSCRA book entitled *British and Foreign Specifications for Steel Castings*, of which Part 1 is now published at 40*s*.

The British Standard is the first part of a series of comparison tables authorised by the Iron and Steel Industry Standards Committee and prepared in collaboration with the British Iron and Steel Federation. The second part will deal with chemical compositions of alloy steels and a further table or tables based on tensile properties will follow. No official guidance as to accepted equivalence is offered and an eagle eye is needed to sort out agreement over and above the major property. Still it is a good start.

With a smaller number of specifications to deal with, the second publication is able to be more comprehensive in the number of countries whose standards are covered. The first part includes Austria, Belgium, France, Western Germany, Eastern Germany, Great Britain, Sweden, Switzerland, and the USA. In addition lists of standards current in Czechoslavakia, Holland and Italy are included. The second part will include the Commonwealth countries and additional foreign countries. Mechanical and chemical properties are tabulated in sections devoted to each country and guidance is given on what is the nearest British equivalent.

In recognition of the fact that mechanical tests differ in the form and geometry of the test piece used, there is a useful appendix in which dimensions are given of several important specifications.

British Standards Institution, 2 Park Street, London, W1.
British Steel Castings Research Association, East Bank Road, Sheffield 2.

British Oil Quest

During last November, exploration for oil in Great Britain was carried yet a stage further by a marine seismic survey in the waters off the south-west coast of the Isle of Wight. The object of the survey was to investigate the nature of the geological structure beneath the bed of the English Channel.

It has long been established that the anticline—an earth fold in which the strata are uplifted in the form of an arch—on this part of the island's coast is of the same kind in which oil is sometimes found and that it may extend some way out to sea. The results of this study will influence the decision as to whether or not to drill for oil on land in this part of the Isle of Wight.

A shot is fired near the Isle of Wight.

The operation was undertaken by Seismograph Service Limited, and was part of the search for possible oil-bearing rock formations which the British Petroleum Company has been carrying out in many parts of the British Isles for nearly 25 years, a search which led to the discovery and development of the producing fields in the Midlands.

Plain Words

By Capricorn

According to my calculations, there have been only 15 engineers who have achieved the distinction of being President of two of the senior engineering institutions. A. C. Hartley, who died last week during his term of office as President of the Institution of Civil Engineers, was the fifteenth. He had been President of the Institution of Mechanical Engineers in 1951, and had taken the chair on the other side of Storey's Gate only last November.

Such a feat did not become possible until 1847, the year the Mechanicals was founded (the Civils had been founded in 1818). Robert Stephenson was the first to make it—in 1855—when the Civils elected him. He had been President of the Mechanicals in 1848, the year after his father had been the founder President.

There was then a gap of 17 years before the double distinction was repeated. Sir William Siemens, in 1872, did it better than anyone has done it since—he became President of two institutions in the same year: of the Mechanicals, and of the Electricals as their first President.

The widest gap between holding the two offices occurred in the case of Dr. W. H. Maw: the Mechanicals elected him in 1901 and the Civils 21 years later. He was Editor of ENGINEERING from 1870 to 1924.

Of the 15 engineers, I found that the majority had been honoured by the two senior institutions. Only four had been President of the Electricals, which is a small proportion even allowing for the fact that the Institution was not founded until 1871. The four were Sir William Siemens, Alexander Siemens (IEE, 1894 and 1904: ICE, 1910), Sir William Henry Preece (IEE, 1880 and 1893; ICE, 1898), and—bringing the exclusive tradition right up to date—Lord Nelson, who as Sir George Nelson was President of the Electricals in 1955 and of the Mechanicals in 1957.

No one yet has been President of the three senior institutions. Though it would be a wonderful distinction for the first engineer to achieve it, I am glad it has never happened. It should be possible to find sufficient men with outstanding records of service to be able to fill the presidential chairs with new names every year.

Presumably with the memberships of the institutions becoming much larger than they were even before the Second World War—and vastly larger than they were in the 19th Century—the chances of an engineer being president of two institutions are growing less. But it is just possible that this factor will be counterbalanced by the natural wish of councils to elect the most distinguished man they can choose, provided he can accept the invitation, because the President's job is no sinecure.

It demands a willingness to devote much time to travelling, attending meetings and giving thought to major questions of policy.

Letters to the Editor

Concrete Strengths

SIR, I read with interest Dr. J. M. Plowman's "Concrete Strength Near Freezing Point" (ENGNG., 15 Jan. '60, p. 78). Dr. Plowman's work on the maturity of concrete is helping to resolve some of the difficulties of determing the effect of time and temperature on the resulting strength.

I should like, however, to take issue with Dr. Plowman on one small point unconnected with the value of his work. At the beginning of his article he says that his previous work resulted in "Plowman's law." What Dr. Plowman means by this is that he has proposed a hypothesis and by its use he has been able, so far, to predict from known conditions the physical behaviour of concrete under a different set of conditions.

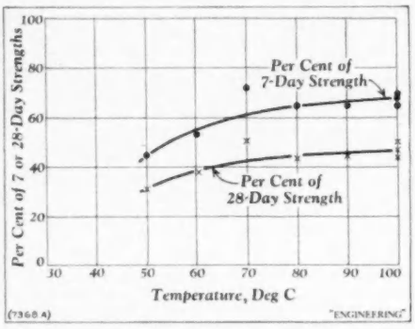


Fig. 1 The effect of curing water temperature on the strength of the resultant concrete as found for Blue Circle ordinary Portland cement.

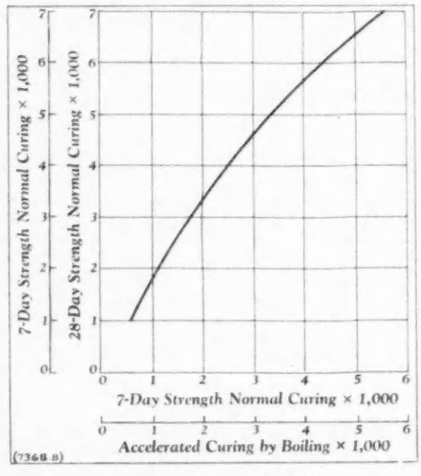

7-Day Strength Normal Curing × 1,000
28-Day Strength Normal Curing × 1,000
7-Day Strength Normal Curing × 1,000
Accelerated Curing by Boiling × 1,000
(7368 B)

Fig. 2 The relationships between the 28-day and 7-day strengths of concrete and between the 7-day strength and the accelerated curing strength are similar. The curve represents this common relationship.

In the discussions on his original paper to the *Magazine of Concrete Research*, it was suggested that perhaps he did not mean the word "law" to be taken literally, but I fear he does. In this case, it is as well to remember, perhaps, that "law" can be divided into a number of categories. The jurist, John Austin, in his lectures, "The Province of Jurisprudence Determined," published in 1832, separated Laws Properly So Called, from Laws Improperly So Called. This latter category included expressions of the uniformities of nature, and Dr. Plowman's "law" so obviously falls within the category of Laws Improperly So Called that perhaps it is time he stopped calling it a Law!

Referring now to the text of his article. Dr. Plowman says, in regard to Portland cement, that it is also known that temperatures near boiling point change the nature of the reaction so that the rate of hardening differs from that at lower temperatures. I should like to draw his attention to an earlier article published in your journal (ENGNG., vol. 181, 1956, p. 153). This article by Mr. R. G. Smith-Gander and myself included the graph reproduced here as Fig. 1. From this result at least it is not possible to say that the temperature at boiling point makes such a tremendous difference to the rate of hardening.

During a discussion of Professor J. W. H. King's paper on the accelerated curing of concrete at the Centenary Conference of the Institution of Structural Engineers I published the information given in the accompanying Fig. 2. This information is based on the fact that if one determines the strength of concrete cubes which have been cured normally for 24 hours, boiled for 3½ hours and lastly tested in compression at an age of 28½ hours, and then compares that accelerated strength with the strength of cubes cured normally for seven days, one finds that the accelerated strength bears the same relationship to the seven days as does the seven-day strength to the strength at 28 days. This relationship is shown in Fig. 2.

It so happens that the maturity of the accelerated cubes bears approximately the same relationship to the maturity of the seven-day cubes as does the maturity of the seven-day cubes to those at 28 days, namely 25 per cent. The inference is that the boiling of concrete cubes has no effect on the strength maturity relationship but, as I said in a letter to you (ENGNG., vol. 186, 1958, p. 36), I feel that Plowman's maturity relationship and Ordman and Bondre's modification of it are not applicable to the accelerated curing of concrete.

Yours faithfully,

T. N. W. AKROYD.

Constructional Services Limited,
123 Victoria Street, London, S.W.1.
26 January, 1960.

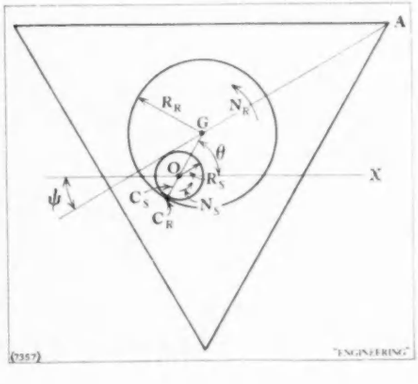
NSU-Wankel Engine

SIR, Your description of the NSU-Wankel engine (ENGNG., 25 Dec. '59, p. 676), together with the discussion by Mr. W. A. Woods of the internal shape of the cylinder (ENGNG., 15 Jan. '60, p. 76), permit the determination of the relationship between the ratio N_S/N_R of the angular speeds of the shaft (N_S) and rotor (N_R) and the ratio R_R/R_S of the radii of the rotor gear (R_R) and the output shaft (R_S). As will be shown below,

$$\frac{N_S}{N_R} = 3 - 2\frac{R_R}{R_S} \quad . \quad . \quad . \quad (1)$$

from which it follows that the 25 December description contains the following contradictions:

If "the speed of the rotor is two-thirds of the speed of the shaft," then N_S/N_R is equal either to $+3/2$ or $-3/2$. In the first case, equation (1) gives $\frac{R_R}{R_S} = \frac{3}{4}$ which is impossible, because R_R cannot be smaller than R_S. In the second case, which conflicts with the directions of rotation implied by the diagrams of 25 December,



$\frac{R_R}{R_S} = \frac{9}{4}$, and this disagrees with gear ratio (3/2) suggested by the diagram. Furthermore, $R_R/R_S = 3/2$ must be rejected because it corresponds to an engine whose output shaft remains permanently at rest.

Equation (1) is obtained as follows: as shown in the accompanying diagram, let O be the centre of the output shaft; OX a fixed line; G the centre of the rotor gear (and the centroid of the rotor); and A one of the vertices of the triangular rotor. Then, as the curve on which A moves is such that $\psi = \theta/3$ the angular speed N_R is given by

$$N_R = \frac{d\psi}{dt} = \frac{1}{3}\frac{d\theta}{dt}$$

so that

$$\frac{d\theta}{dt} = 3\,N_R \quad . \quad . \quad . \quad (2)$$

Next, express the speed V of point G in two ways: regarding G as a point moving on a circle of radius $R_R - R_S$, centre at O,

$$V = (R_R - R_S)\frac{d\theta}{dt}$$

or using equation (2)

$$V = 3\,(R_R - R_S)\,N_R \quad . \quad . \quad (3)$$

Alternatively, V must be such that the velocity of G is equal to the vector sum of the velocity of G relative to point C_R and the velocity of point C_S, C_R and C_S being those points of the rotor gear and of the shaft which are instantaneously in contact with each other. Thus,

$$V = R_R N_R - R_S N_S \quad . \quad . \quad (4)$$

Finally, equate the right-hand members of equations (3) and (4), and solve for N_S/N_R, which results in equation (1).

Yours faithfully,

T. R. KANE.

Manchester College of Science and Technology,
Sackville Street, Manchester 1.
21 January, 1960.

Drawing Office Space

SIR, I have read with interest the article entitled "Design and Equipment of Drawing Offices: Part 2—Layout and Equipment," by Dr. F. J. Langdon (ENGNG., 24 April '59, p. 558).

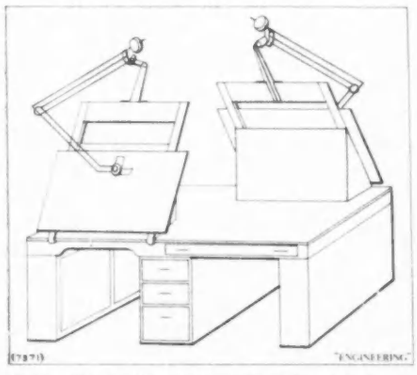
In the Transmission Drawing Office of the Electricity Commission of New South Wales, Australia, use is made of a duplex drawing table using vertical drafting machines. The arrangement considerably reduces the space required for each draughtsman.

The accompanying drawing of the drafting table should be of interest to a large number of your readers.

Yours faithfully,

A. B. HOORE,
Supervising Engineer,
Transmission Drawing Office.

Electricity Commission of New South Wales,
Corner of Goulburn and Riley Streets,
Sydney, New South Wales.
14 December, 1959.



Isometric view showing the general arrangement of a duplex drafting table.

Lightweight Fire Protection

SIR, Referring to the notes on the advantages of lightweight fire protection for steelwork in your issue of 22 January (pages 109 and 115) we would point out that we have been carrying out lightweight fire protection, using sprayed-on vermiculite plaster, since 1957.

We would much appreciate it if you would correct any impression given that this method of fire protection and application is hitherto unknown in the United Kingdom. Our gun is the subject of a provisional patent.

Yours faithfully,

B. B. ALDRED,
Director.

Lomac Fireproofing Limited,
62 Costock Avenue,
Sherwood, Nottingham.
29 January, 1960.

Events in Advance

Automation in Clothes

No fewer than six exhibitions connected with clothing, textiles, and their accessories are being held in this country, principally in London, during the present month. Three other exhibitions of the same character are due to take place later in the year. Together, these events will cover almost every section of this very broad field of industrial activity. They will show a wide range of up-to-date textile machinery, as well as numerous examples of modern fabrics, both natural and artificial.

Owing to rapid advances in the world demand for ready-made clothes, clothing manufacturers are unceasingly on the lookout for new ideas in techniques and equipment, with a view to speeding up production and thereby being able to dispose of their wares more cheaply. During the last two years, the introduction of automatic and semi-automatic machinery has enabled many advances to be made in this direction.

Exhibitions and Conferences

"Designing Things and Symbols: The Work of a General Consultant Designer."—Fri., 5 Feb., to Sat., 5 Mar. An exhibition of the work of F. H. K. Henrion, M.B.E., R.D.I., F.S.I.A., ranging from heavy engineering and product design to house styles and trade marks; from magazines, posters and textile designs to packaging and exhibition. On show at the Institute of Contemporary Arts, 17 & 18 Dover Street, London, W1. Tel. GROsvenor 6186.

Nylon Fair, Fifth National.—Mon., 8 Feb., to Fri., 12 Feb., at the Royal Albert Hall, Kensington Gore, London, SW7. Organised by Trade Fairs and Promotions Ltd., Drury House, Russell Street, London, WC2. Tel. TEMple Bar 3422.

Men's and Boys' Trade Fair, Seventh.—Mon., 15 Feb., to Fri., 19 Feb., at the Royal Albert Hall, Kensington Gore, London, SW7. Organised by Trade Fairs and Promotions Ltd., Drury House, Russell Street, London, WC2. Tel. TEMple Bar 3422.

Carpet, Linoleum and Floor Coverings Trade Fair, Fourth National.—Mon., 22 Feb., to Fri., 26 Feb., at Earl's Court, London, SW5. Organised by Trade Fairs and Promotions Ltd., Drury House, Russell Street, London, WC2. Tel. TEMple Bar 3422.

Household Textiles and Soft Furnishings Trade Fair, Seventh.—Mon., 22 Feb., to Fri., 26 Feb., at the Royal Albert Hall, Kensington Gore, London, SW7. Organised by Trade Fairs and Promotions Ltd., Drury House, Russell Street, London, WC2. Tel. TEMple Bar 3422.

British Hosiery and Knitwear Exhibition Third.—Mon., 29 Feb., to Fri., 4 Mar., at the Royal Horticultural Society's New Hall, Greycoat Street, London, SW1. Organised by Industrial Exhibitions (Services) Ltd., 9 Argyll Street, London, W1. Tel. GERrard 1622.

Smallwares Trade Fair, Seventh.—Mon., 29 Feb., to Fri., 4 Mar., at the Queen's Hotel, Hastings. Organised by Trade and Technical Exhibitions, 1 Dorset Buildings, Salisbury Square, London, EC4. Tel. FLEet Street 1555.

Meetings and Papers

British Institution of Radio Engineers

LONDON
"Drift Correction of Direct-Current Amplifiers," by D. Leighton Davies. Computer Group. London School of Hygiene and Tropical Medicine, Keppel Street, WC1. Tues., 9 Feb., 6.30 p.m.*

Chemical Society

DURHAM
"Anti-Knock Action of Tetraethyl-lead," by Professor A. D. Walsh. Durham Branch. Science Laboratories, South Road, Durham. Mon., 8 Feb., 5 p.m.

Illuminating Engineering Society

SHEFFIELD
"Lighting Design," by W. Robinson. Sheffield Centre. Grand Hotel, Sheffield. Mon., 8 Feb., 6.30 p.m.

Institute of Fuel

MANCHESTER
"Rocket Fuels," by Professor A. D. Baxter. North Western Section. Engineers' Club, Albert Square, Manchester. Wed., 10 Feb., 2.30 p.m. (Preceded by luncheon at 1 p.m.)

Institute of Marine Engineers

LONDON
"Some Crankshaft Failures: Investigations, Causes and Remedies," by R. Atkinson and P. Jackson. Tues., 9 Feb., 5.30 p.m.*

Institute of Metal Finishing

LONDON
"Choice of Application Methods for Organic Finishes," by E. Podmore and D. W. Hislop. British Institute of Management, 80 Fetter Lane, EC4. Wed., 10 Feb., 6.30 p.m.

Institute of Metals

LONDON
"Solidification of Alloys," by Dr. W. C. Winegard. Wed., 10 Feb., 6.30 p.m.

Institute of Physics

LIVERPOOL
"Nuclear Models," by Dr. L. L. Green. Liverpool and North Wales Branch. The University, Liverpool. Thurs., 11 Feb., 7 p.m.

Institute of Road Transport Engineers

CARDIFF
"Transport Developments in the USA in 1957," by John F. Moon. South Wales Centre. South Wales Institute of Engineers, Park Place, Cardiff. Fri., 12 Feb., 7.15 p.m.

Institution of Civil Engineers

LONDON
"Stresses in Foundation Rafts," by Professor D. N. de G. Allen and R. T. Severn. Tues., 9 Feb., 5.30 p.m.*

Institution of Electrical Engineers

LONDON
"Present Views on Ground-Wave Propagation." Discussion opened by G. Millington. Electronics and Communications Section. Mon., 8 Feb., 5.30 p.m.*
"Design of Housing-Estate Distribution Systems Using a Digital Computer," by Dr. R. L. Grimsdale and P. H. Sinclare; and "The Logical Design of Electrical Networks Using Linear Programming Methods," by U. G. W. Knight. Supply Section. Wed., 10 Feb., 5.30 p.m.

Institution of Mechanical Engineers

LONDON
"Construction and Behaviour Characteristics of Tyres," by T. French. Automobile Division. Tues., 9 Feb., 6 p.m.*
"The Case for the Development of Steam Turbines up to 10,000 kW Capacity for Higher Steam Pressures and Temperatures." Thurs., 11 Feb., 6 p.m.*

Institution of Plant Engineers

MANCHESTER
"Problems in Chemical Engineering Maintenance," by J. C. Veale. Manchester Branch. Engineers' Club, Albert Square, Manchester. Tues., 9 Feb., 7.15 p.m.

Royal Institution

LONDON
"Fuel Cells: Will They Soon Become Major Sources of Electrical Energy?" by F. T. Bacon. Fri., 12 Feb., 9 p.m.

The address and telephone number of the headquarters of each institution are given below. Meetings in the headquarters town are held there unless otherwise stated. An asterisk (*) is placed where it is understood that refreshments are available prior to the time stated.

British Institution of Radio Engineers, 9 Bedford Square, London, WC1. (MUSeum 1901)
Chemical Society, Burlington House, Piccadilly, London, W1. (REGent 0675)
Illuminating Engineering Society, 32 Victoria Street, London, SW1. (ABBey 5215)
Institute of Fuel, 18 Devonshire Street, Portland Place, London, W1. (LANgham 7124)
Institute of Marine Engineers, Memorial Building, 76 Mark Lane, London, EC3. (ROYal 8493)
Institute of Metal Finishing. Apply to 11A Gloucester Road, London, SW7. (KNIghtsbridge 9181)
Institute of Metals, 17 Belgrave Square, London, SW1. (BELgravia 3291)
Institute of Physics, 47 Belgrave Square, London, SW1. (BELgravia 6111)
Institute of Road Transport Engineers, 69 Victoria Street, London, SW1. (ABBey 6248)
Institution of Civil Engineers, Great George Street, London, SW1. (WHItehall 4577)
Institution of Electrical Engineers, Savoy Place, Victoria Embankment, London, WC2. (COVent Garden 1871)
Institution of Mechanical Engineers, 1 Birdcage Walk, St. James's Park, London, SW1. (WHItehall 7476)
Institution of Plant Engineers, 2 Grosvenor Gardens, London, SW1. (SLOane 0469)
Royal Institution, 21 Albemarle Street, London, W1. (HYDe Park 0669)

Factory Rebuilt While Work Continued

By rebuilding above the existing single-story structure, a factory has been modernised without cutting production or moving site. The press shop has been put on a suspended floor with advantage.

Modernisation of nearly four acres of an old-established works—without re-location and consequent loss of a skilled labour force and orders—has been carried through in a novel way by Joseph Sankey and Sons Limited, one of the Guest, Keen and Nettlefolds group of companies, at their Albert Street works, Bilston. They rebuilt on the same site, erecting nearly half of the new production departments over the old ones, and then, while production continued, demolished the old buildings underneath.

This £1½ million scheme has brought all the assembly shops on one level; constructed a new 64,000 sq. ft press shop on a suspended floor, the slope of the ground forming a basement used as a multiple tool and raw materials store; and linked two halves of the works with a 250 ft conveyor which had automatic facilities for shunting pallet loads of materials.

Concurrently, the scope and capacity of Sankeys' work was increased, additional general purpose equipment and more flexible plant layout permitting a wide range of manufactures from durable consumer goods to aircraft parts, gas-turbine components, and chassis and body work for the automobile industry.

The order in which rebuilding could be carried out was determined largely by the new facilities which were being provided. Use was made of the existing heating capacity from the central boiler house serving Albert Street and neighbouring works of the company, thus allowing the existing boiler house and adjacent buildings to be demolished, pickling and plating shops rehoused, and a new neutralising tank to be built before construction began on the press shop.

Work on the new press shop enabled major plant moves to take place. The space thus vacated was used as temporary housing for the assembly departments while further demolition and construction was undertaken.

Sankeys operated during the demolition and rebuilding period with an average of 25 per cent less floor space than was previously available, and for the Albert Street rebuilding, therefore, it was necessary to erect the new structures before the old ones could be demolished and to continue working throughout the period that building was in progress.

This was achieved by piling approximately 80,000 sq. ft in the production departments, and subsequently Sankeys' workmen, who erected the structural steelwork, lowered the stanchions of the new building through holes made in the roofs of the old shops, and then fixed the stanchions to the pile caps. The new building was cladded and finished on top of the old one which was later demolished from underneath the new.

Major plant moves were planned to take place during the night, at weekends or during holidays. Production runs were lengthened to reduce down-time and stocks of finished products were increased and stored in temporary rented warehouses to simplify the whole problem of production planning during the course of the demolition and rebuilding.

During this period output increased by 12½ per cent.

Because of the poor nature of the subsoil, which was largely made-up ground above old mine workings, 1,037 piles were driven, the maximum depth being 35 ft and the average 25 ft. Each pile was designed for 60 tons loading. The concrete mix had to be continuously adjusted as the surrounding subsoil was heavily contaminated with acids and alkalis. Nearly 100,000 cu. yd of soil, brick and concrete obstruction were excavated or blasted for the new shops.

The rebuilt factory of Joseph Sankey at Bilston. On the left is the press shop, in the centre are the assembly shops and new offices on the right.

The construction of the press shop began in August, 1957, and the first presses were operating by Easter, 1958. The size of the shop is 425 ft by 150 ft and the height to the underside of the truss is 40 ft, with 12 ft of truss and glazing. Dado walls are of brickwork with side wall glazing and monitor light roofs.

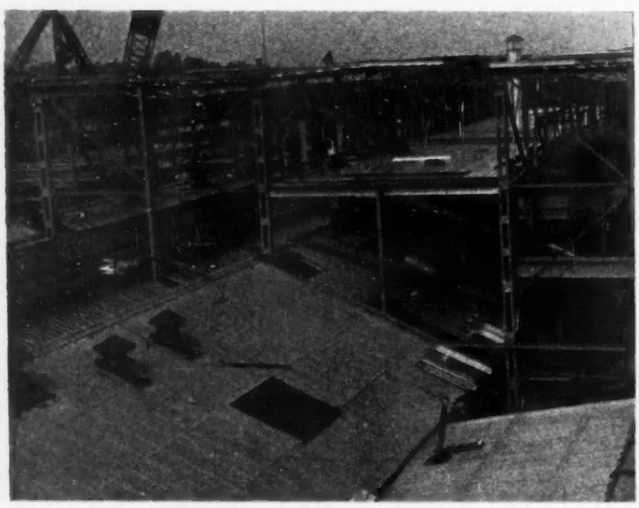
The new basement area is 63,750 sq. ft in area, with a depth of 20 ft. It contains a tools store (18,000 sq. ft), materials store (42,520 sq. ft), laboratory (450 sq. ft), and a tool repair section (2,780 sq. ft). Adjoining is housing (2,660 sq. ft) for a Lindemann hydraulic scrap baler.

The floor stanchions are based on a 25 ft square grid. The main beams are 54 in deep with cross beams between, and the floor designed to carry 1 ton per sq. ft superimposed load. Removable hardwood panels on the steelwork over the basement allow for re-location of presses without the necessity for excavating and constructing new individual press pits and foundations. The basement also allows for the shedding of scrap off-cuts from the presses—the scrap dropping down specially constructed chutes into scrap bins.

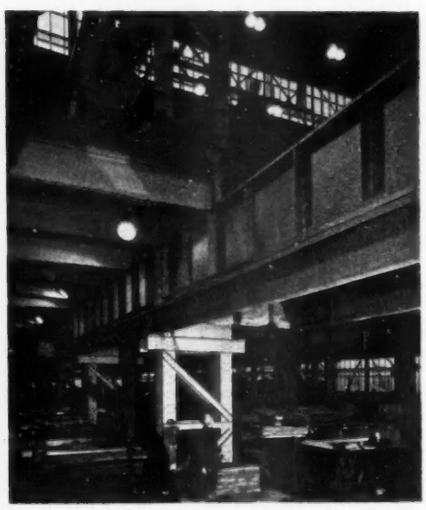
The press shop contains over 100 presses, from 25 to 1,000 tons capacity, arranged in four lines—two lines each for the heavy and light press bays. All the aisleways are wide enough to allow for efficient materials handling and die setting, and the presses are installed in tandem fashion to allow for smooth production flow.

The heavy press bay is equipped with two 30 ton cranes, and there is one in the light press bay. There are 5 ton cranes in the basement for materials handling.

To further reduce handling time, equipment for material preparation is situated near the materials store in the basement. The equipment consists of several sets of squaring shears, angle benders, circling machines and profile circlers.



(*Left*) *2 acres of new shops were built above old. After putting down piles between machines that were kept working, the new stanchions were lowered through holes in the old roof. When the new upper storey was complete, the old building below was remodelled.*



(*Right*) *Steelwork for the suspended floor of the press shop. Location of the presses on an upper floor eliminates individual press pits and allows for easy re-siting of presses. Bins for off-cuts are easily accommodated.*

On completion of the press shop, reconstruction began on four assembly shops and warehouses. These covered an area of 102,000 sq. ft and, with the exception of two shops and the warehouse (24,640 sq. ft), the new shops were erected over the old ones as already described. The shops have brick dado walls, side wall glazing and monitor light roofs; the height to underside of truss is 32 ft and the depth of truss and glazing 12 ft.

Access was limited and difficulty was experienced in moving building plant among the production machinery. Concrete was pumped right across the press shop into the assembly buildings, the pipes being disconnected at certain times to allow movement of Sankeys' materials.

The shops were reconstructed a section at a time. Machinery was removed to the adjoining section, concrete flooring and brickwork (where necessary) was laid, then the machinery was replaced and the process repeated. The concrete flooring was often in use 48 hours later.

Designs for the rebuilt factory were made by Howard Crane and Partners, 132 Sloane Street, London, SW1; the main contractor was Sir

Three of the 100 presses that have been sited on a suspended floor in Sankey's remodelled works. Press capacities range from 25 to 1,000 tons.

Alfred McAlpine and Son Limited, Little Sutton, Wirral, Cheshire. The piling contractors were John Gill (Contractors) Limited of Pall Mall, London, SW1, and the structural steelwork was supplied by British Steel Construction (Wednesbury) Limited.

Hydro-electric Power in Canada

For the second consecutive year, Canada has brought into operation a greater amount of hydro-electric power than hitherto. A total of 2,508,800 h.p. of new capacity was commissioned during 1959. This information and an analysis of the distribution of the new works is given in a bulletin (No. 2700) entitled *Hydro-electric Progress in Canada, 1959*, just issued by the Water Resources Branch, Department of Northern Affairs and National Resources, Ottawa (copies can be obtained free of charge).

Installations currently under construction are expected to add another 1,700,000 h.p. during 1960, and projects in hand or in active prospect for future development represent another 2¼ million h.p. The total installed capacity of water power plants in Canada is put at nearly 25 million h.p. It is noted in the bulletin that new hydro-electric sites are becoming more and more remote from established areas of demand; for this reason thermal stations were now being constructed on a major scale. Such stations were being built or extended in nine out of the ten provinces and also in the Yukon and Northwest Territories. The greatest increase in thermal capacity during the year was made in Ontario, where the principal hydro-electric sites within economic transmission distance of users have been largely completed.

Global Study of Water Resources

Plans are under consideration for a world-wide project to measure the tritium concentrations in water. Such a survey would provide information on ground water resources, rates of ground water flow, and on the rate of mixing of water in lakes and between the surface and deep layers of the sea. Also, for example, by measuring the difference between concentrations in the water flowing into and out of a lake, the average age of the water in the lake could be estimated.

Again, tritium measurements can yield information on the age and size of ground water systems and provide data on the storage time and flow of such water for the catchment area of a river.

Tritium (hydrogen 3) is the radioactive isotope of hydrogen and the project is being examined by a panel convened by the International Atomic Energy Agency. The British representative on the panel is Mr. D. B. Smith of the Harwell Research Establishment.

Synthetic Aggregate for High Strength Concretes

A synthetic aggregate made specially for use with Ciment Fondu high alumina cement is announced by the Lafarge Aluminous Cement Company Limited. Called Alag, the aggregate resembles a crushed basalt, is non-absorbent and has a hardness of 7 to 7½ mohs (between quartz and topaz) which is sufficient to cut glass.

Ciment Fondu/Alag concrete is claimed to have a crushing strength of 13,000 lb per sq. in at 24 hours and 16,000 lb per sq. in in 7 days. Its air-cured density is 170 lb per cu. ft and it will withstand temperatures up to 1,200° C when its strength is still of the order of 2,800 lb per sq. in. The thermal conductivity is also high. About 1½ to 2 times the amount of water is required for mixing as for normal Portland cements. The combined properties make the resulting concrete well suited for use in the biological shields for atomic reactors.

Alag is available in two sizes: coarse, ¼ in to $\frac{3}{16}$ in; and fine, $\frac{3}{16}$ in to dust. It is supplied in bags or in bulk, and should be stored in a dry place.

Water Resources in Asia and Far East

The Economic Commission for Asia and the Far East are to hold their fourth regional technical conference in Colombo, Ceylon, between the 5 and 13 December, 1960. A review will be undertaken of the development of water resources in the region during the decade to 1960. General studies will cover the organisation of river valley projects and the assessment of ground water resources. A programme of future works, and priorities, will be established.

A special study will be concerned with flooding in deltaic regions, and will discuss siltation, the prevention of salt water infiltration, and the reclamation of salt impregnated lands.

Repair of "Live" Sewers

Some 650 ft of an old leaky stoneware sewer serving a Berkshire village have been repaired while being kept in use and with the minimum of excavation by driving 6 in Key pitch fibre pipes through the old 9 in sewer. The village sewerage system was over 50 years old and terminated in the 9 in sewer which discharged into an underground pump house adjacent to a river. The sewer was laid at a depth of 8 ft through waterlogged ground and the pumping system was grossly overloaded by the infiltration of ground water. The flow was in fact nearly ten times the 7 gallons per minute that was to be expected from the population served.

Excavations had to be made at every house to make the service connections and it was intended to drive the new pipes from one opening to the next. This was generally successful, though broken pipes and accumulated silt made some additional pits necessary. The Key pipes were driven through the old sewer using a sledge hammer and protecting the ends of the pitch pipes with a timber dolly; the longest length so driven was 90 ft. The space between the old and new pipes was grouted with cement under pressure. On completion of the work the electrical consumption of the pumps dropped from an average of 65 units to about 10·5 units a day, and the night flow on the whole system fell to 3·5 gallons per minute.

The consulting engineers who advised on the scheme were Howard Humphreys and Sons, of Victoria Station House, London, SW1, and the contractors H. N. Edwards and Partners Limited of Basingstoke. The pitch fibre pipes were made by the Key Engineering Company Limited of Larkfield, Kent. It is estimated that the cost of the work was just under half that of taking up and relaying the whole length of the sewer, and, of course, there was much less inconvenience to passers-by.

Light Alloy Roofing Shingles

Thin-gauge aluminium shingles used above felt have been introduced into the United States for roofing purposes.

A heavy asphalt impregnated felt is first laid on the roof and then covered with the shingles, which have a width of 4 ft and are set to have an exposed face of 7 in. Any water which does not run off this metal surface is easily absorbed by the felt. In addition, the aluminium reflects the sun's radiant heat and also protects the felt from ultra-violet light, both of which have a deleterious effect on asphalt. The combination is said to be competitive with wood or composition shingles, and to have a life that is equal to that of any house.

Severn Bridge Approaches

A draft Order has been published providing for alterations to public roads and footpaths in the neighbourhood of the site for the Severn suspension bridge. The alterations are required because access to the approaches, apart from the terminal junctions with the A38 on the east and the A48 on the west of the river, will be limited to two junctions with existing main roads. These junctions will be with the Aust-Almondsbury road (B4461) by a spur road at Aust, and with the Newhouse Farm road and the future Wye Valley Link Road.

It is expected that work on the new bridge will be phased to make use of steel fabrication capacity and equipment now engaged or required on the Forth bridge, which is due to be completed in 1962.

Suspension Bridge over the Bosphorus

The Turkish Government has announced that it is going ahead with the construction of a suspension bridge over the Bosphorus. It is to be a toll bridge. The designs have been prepared by the American consultants, N. B. Steinman and Partners.

The bridge, the first across the straits, will be 1,358 m long, of which 1,060 m will be over the water. (Agency messages from Ankara do not indicate the length of the clear span between the towers.) Clearance above the water is to be 55 m. sufficient to allow the passage of any ship likely to use the straits. The bridge will run from Ortakoy on the European side to Beylerbey on the Anatolian side and is expected to cost 442 million Turkish lira (about £18 million). Contracts for the construction of the bridge are being put out for tender.

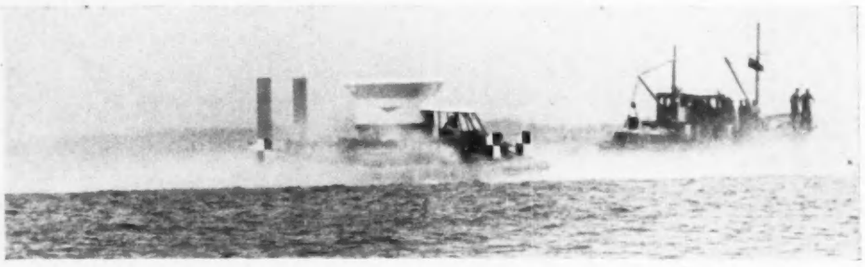
Earth Dam in County Durham

A new reservoir, with a capacity of 11,000 million gallons and a daily yield of 32 million gallons, is to be built five miles west of Consett, County Durham. It will be contained by an earth dam 3,000 ft long and 116 ft high that will be one of the largest in the country. To cut off water seepage under the dam, a trench 200 ft deep but only 6 ft wide will be cut for the length of the dam for a concrete skirt. The reservoir will be 3½ miles long by 1 mile wide.

The reservoir is to be built at a cost of £5½ million by John Mowlem and Company Limited for the Sunderland and South Shields Water Company in association with the Durham Water Board. The work will be supervised by Mr. A. G. McLellan, M.I.C.E., general manager of the water company.

Crossing the Channel without a Tunnel

An announcement regarding the building of a channel tunnel is expected soon. Even if building starts right away, it will take several years to complete. In the meantime many more cars are pouring across the channel each year.



During 1959 some 290,000 cars were ferried across the English Channel. This year some 320,000 cars are expected to make the same crossing. At this rate of expansion a figure of about half a million may be reached by 1965 and more than three-quarters of a million by 1970.

At the moment the Channel can be crossed in about an hour and a half by boat and from 20 to 40 minutes by air. Various hold-ups may be experienced due to the Customs and bad weather but, by and large, delays are rarely unreasonable. However, if existing facilities are stretched very much further, things could come to a standstill.

There is a good chance, in fact many think it inevitable, that a tunnel will be built under the Channel some day but, even if the go-ahead were given immediately, it would take several years to complete. We cannot, therefore, look to the tunnel to solve the problems that will inevitably arise in the next decade or two.

(*Above*) *The hovercraft needs further development before it can become fully operational.*

(*Left*) *Silver City Airways offer Quick service and are becoming increasingly popular.*

(*Right*) *The sea ferry is still the mainstay of cross-channel traffic.*

In this case, what other possibilities are there? Well, first and foremost there is the hovercraft, which is well out of the research stage and now undergoing intensive development. It is hoped that in less than two years a prototype 40 ton model will be undergoing operational trials on a waterway such as the Solent. Such a craft would be capable of carrying about ten cars and up to 60 people and could move at a rate of 80 knots.

However, although the SRN-1 has already succeeded in crossing the Channel, the business of routine operational ferrying is another matter entirely. Those engaged upon the development of the hovercraft are confident that it will eventually be able to cope with the rough seas and high winds that are so frequent on the English Channel. But at the moment it is not known how this will be done and so there must be some degree of doubt, not only as to whether the hovercraft can be developed to this stage, but how long such development would take.

If it is assumed that the weather difficulties of the hovercraft had already been overcome, then it would still be some years before such craft could become fully operational since, due to its revolutionary nature, it would need lengthy proving trials. So, in spite of the great promise that the hovercraft shows, like the tunnel, it cannot be relied upon to solve the problem, at least not for some years.

So then, for the next few years at least, we must look to the conventional ship and aeroplane to cope with the increasing demands for car ferrying. This, however, may not be so bad as it first appears. Though people often talk of outrageous delays in getting their cars over to France, there can be no real complaint when the situation is looked at as a whole. Except for Customs delays and stoppages due to bad weather, the majority of both sea and air ferries work with reasonable efficiency throughout the year.

So it would perhaps be a little unfair to criticise the ferry organisations at the moment—but it will be another matter entirely if plans are not carefully laid for the inevitable changes that the near future will bring. For instance, if the amount of cars crossing by sea reaches the estimated figure of 350,000 by 1965, then delays will no longer be mainly due to factors outside the control of the ferry authorities unless the existing facilities are considerably improved.

While it is appreciated that one of the biggest difficulties is created by seasonal fluctuations in the flow of cross-channel traffic (for instance four times as many cars are transported in August as in January) it is no use appealing to the holiday tourist to forego the pleasures of the summer sun in favour of winter sports. A few may cooperate with this appeal, but the majority will undoubtedly not. So, as far as sea ferries are concerned (and they are the biggest and most criticised of the two), three possible lines of approach immediately spring to mind: bigger ships, more ships of the present type, and faster ships.

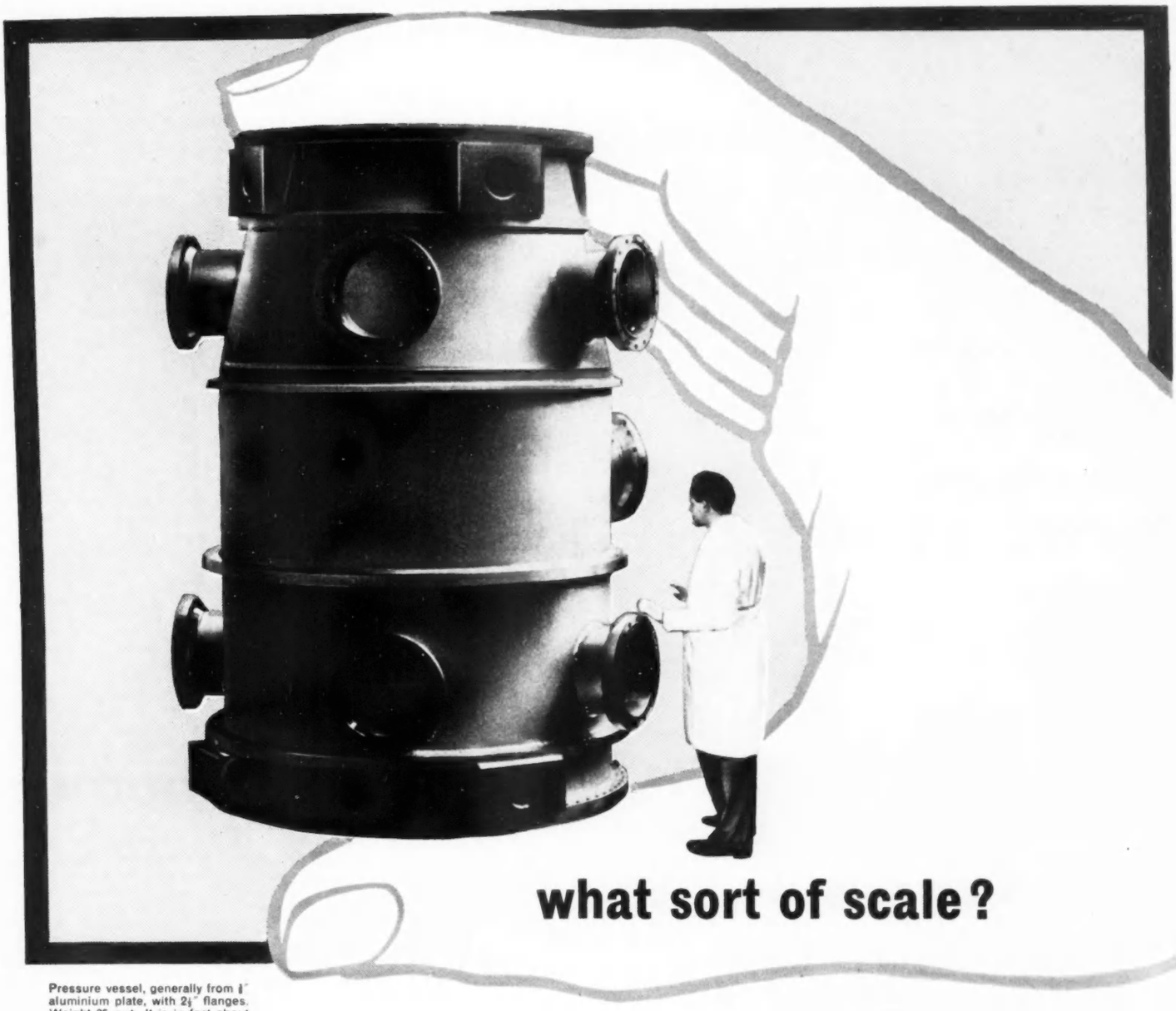
Bigger ships than those operated on the English Channel are in use on other waters. For instance some of the Baltic ferrying vessels are capable of carrying many more cars per trip than the latest and largest of the English Channel vessels. However, in this respect it must be remembered that the Baltic crossings are considerably longer than the Channel, thus favouring the economics of the larger ship.

The idea of having more ships seems perfectly reasonable, but here again the seasonal loading problems become acute because nothing will have been done to raise the utilisation factor and so the overall efficiency becomes worse.

The question of faster ships is relatively unimportant since very much greater speeds would be required to effectively change the ferrying situation. This is in fact where the hovercraft will come into the picture if it ever materialises as a truly practical proposition.

One of the primary advantages of air ferries as far as the traveller is concerned, is the frequency of the service. This means far less anxiety for the traveller about being on time, since missing a plane is not nearly as bad as " missing the boat ". There is also the all important fact that customs delays are greatly reduced by the small numbers of vehicles involved. These are thought by many to be the main advantages of air travel—rather than the speed of the actual crossing. Is it not possible then that smaller ships, and not bigger ones, will be the answer to the problem?

There have always been serious doubts about the philosophy of using bigger and bigger vessels to meet increased ferry demands. Of course, ships could never be built to carry only the small numbers of cars that aircraft carry, but nevertheless it may well be better for the traveller of the future if smaller vessels were put into service, giving conditions approaching those of bus services.



what sort of scale?

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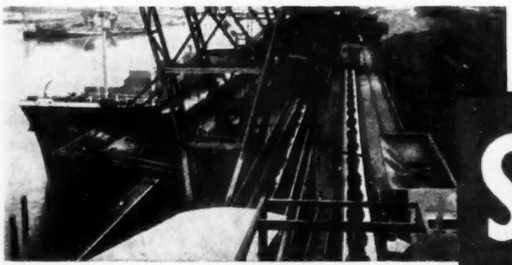

New 60" wharf conveyor shown alongside existing Sutcliffe installation.

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Human Element

Growing Tension on Wages

Having rejected the engineering employers' offer of a 42 hour week, union representatives are to join a joint committee with the employers to examine the offer.

This is not as silly as it sounds. In the broadest terms what the committee has to examine is the whole complex question of shorter hours in the engineering industries. It is already decided that men working on time rates will not earn less by a shorter week. Given the recent revelations on the tendency of overtime to increase, plainly the reverse may well be true.

What is causing trouble is the position of the pieceworkers. In a works whose order book position made it possible just to cut down the hours worked there would be an immediate effect in the pay packet. Once the joint committee gets down to it, this will be one of the main troubles that will have to be removed.

The other snag that brought last week's meeting to a deadlock is the strength of feeling in the rank and file of some unions that a wage increase is overdue and can be afforded. And the union negotiators are in some difficulty. The concession of a 42 hour week in electricity supply may or may not have swayed the engineering employers in making their amended offer. But they are not offering a wage increase.

If the union leaders trying to persuade them otherwise were to call it a day and accept the hours cut alone they would certainly have reduced their chances of getting the wage increase in electricity supply that they are seeking. They would also run head on into some very militant shop stewards and the possibility of unofficial strike action is by no means yet averted.

On Thursday, 11 February, the executive of the Confederation of Shipbuilding and Engineering Unions meets at York to discuss the situation before going on to a meeting of the full executives of all 39 affiliated unions.

That meeting will presumably agree to ask for another meeting with the employers. If settlement is not then reached, as it may well be, then sporadic unofficial strikes will be almost certain to be called for.

Where are the Mechanical Engineers?

One of the most useful general guides for the man approaching his final examinations is *The Directory of Opportunities for Qualified Men*, published by the Cornmarket Press at 8*s* 6*d*.

This year it shows that of almost 100 firms who set out their recruiting needs —52 want mechanical engineers, 44 companies need chemists, 40 are seeking electrical engineers and 39 have vacancies for accountants.

In his preface the chairman of the Rugby Portland Cement company, Sir Halford Reddish, recalls the enthusiasm with which many of the firms with the best career prospects seek the qualified man. He reverses the old tag so that it now reads—"A company is known by the men it keeps."

If the notes on the industries into which a man, or woman, may choose to go are vague—" the vast shape of civil air power to come "—the details of executive courses in 1960 are extremely clear and helpful. The reference section, from Air Products (Great Britain) through British Railways and the Post Office to Wilmot Breeden, is specific about qualifications, possibilities, and in some cases about pay.

Inter-Union Brake on the Railways

One overall union for the British Railways? With the current flow of enmity between three unions such a development may appear as far away as ever it was but outward appearances are deceptive.

The situation before the rank and file of the two minority groups, the locomotive drivers and engine cleaners of the Associated Society of Locomotive Engineers and Firemen, and the clerks of the Transport Salaried Staffs Association, are faced with this situation.

At the last pay award, in June, 1958, the British Transport Commission and the unions agreed to set up a committee to investigate the whole rail pay system. And they agreed that the committee should waste no time about it.

The pay award was 3 per cent more and very many railwaymen, perhaps mostly in the National Union of Railwaymen, rapidly felt that by cuts in overtime and extra day working they had lost at least the extra pay and sometimes more. This was an effect that was naturally scarcely felt by the ASLEF members or those of TSSA. With a dangerous amount of rank and file discontent behind them the NUR leaders put in and had rejected an interim claim for " something on account."

Sympathy

When, a week ago, the union leaders met Sir Brian Robertson, the BTC chairman, it was widely expected that the Commission was ready to meet the by now urgent claim for an immediate increase. The public was widely credited with sympathising with the railwaymen for all that points of irritation and dissatisfaction with the service were as numerous as ever.

Then the two minority unions declined to support the NUR in its claim and Sir Brian was obliged to stand by the agreement to await the result of the committee, due now in April. The national strike threat by the NUR followed within three hours.

What is abundantly plain is that the employers, the Transport Commission, were ready to give the men some more money and the union representing four rail men out of five was there asking for it.

Under these circumstances it is not seriously to be expected that the enormous dislocation to industrial activity and to individual convenience of a national rail strike will be allowed to come about. Instead some way of getting the two smaller unions to accept an increase will be devised, whether at the British Transport Commission or at the Ministry of Labour, of if necessary at No. 10.

In that event the locomen and the clerks will have gained their increase solely because of NUR tactics. Not the most cheery prospect for their representatives.

Sir Brian Robertson said only a few days ago: " Transport operators, railwaymen in particular, have an instinctive affinity." But then union chiefs are not transport operators.

Troubles at British Motors

If one piece of equipment mattered more than another in the film *I'm All Right Jack* it was the fork lift truck. Though the film's strike ended in a more or less national stoppage, the fork lift workers pay claim that sparked off the Rootes Group strike had no such far reaching consequence.

Before the 132 strikers agreed to resume work, 4,000 workers at the Rootes' factories in Coventry had been laid off and so had 3,000 Pressed Steel workers at Cowley, Oxford.

The British Motor Corporation troubles began over even fewer men: 55 maintenance electricians at the strategic transmission and tractor branch at Washwood Heath. Since their pay claim was first made 18 months ago it is not surprising that some militant resentment erupted into a strike.

There is something highly inept about the handling of labour relations when a firm of the size of the British Motor Corporation, producing two of every five cars sold in Britain and sending abroad cars worth £100 million last year, can be brought to the brink of shut down over an 18 month long pay negotiation for 50 men.

When the annual car production figures once again showed Germany in the lead over Britain, it was pointed out that BMC had the means to put Britain ahead if the company were not hamstrung by constant strikes. There are special factors, such as high earnings and high levels of income tax, the BMC's need for the men and the men's feeling that something more can always be taken from so booming an industrial giant. But they are not as special to the BMC as its quite outstanding record of days lost in disputes.

With 20,000 worders idle, and the imminent possibility of another 25,000 having nothing to do as the supply of back and front suspensions dried up, the area secretary of the Electrical Trades Union met the BMC labour director at a meeting arranged by local Ministry of Labour officers. This meeting failed. The ETU secretary later stated that he had only been offered a re-statement of the BMC's offer which he had already described as containing figures which were " completely misleading." The company notices stated that the terms of their offer would give electricians between 11*s* 6*d* and 25*s* a week more. The union representatives say that in reality the electricians mates would receive another 7*s* 4*d* in some weeks only 4*s* 4*d*.

Other troubles were about in the car firms. Fifty-three Rover machinists stopped work in protest at two more men being put into their shop. The danger there was of a slow down as stocks ran down.

Wipe Your Feet on the Grille

Wiping the feet on the mat is vaguely associated with hygiene by most of us. But not by Mr. Frank Elvy, who this week put on a stimulating Cleaning and Maintenance exhibition at the Seymour Hall in London.

That door mat is home to more germs and dust than anywhere else in the home or the office. Mr. Elvy, head of the Comex-Fraser Tuson firm would like to see it replaced with the rubber grille mat now widely used in Scandinavia.

The exhibition showed a multi-purpose machine which, as it polishes floors, sucks up the dirt and has a particularly efficient filter. Machines and methods that amount to the biggest single onslaught of ideas on dust and infection in the home in hospitals and in industry were assembled for the show.

The Pattern of 1959's Strikes

The figures for days lost in industrial disputes last year show very markedly how the most highly publicised disputes are not the most costly in loss of working time.

A hypothetical questionnaire asking what was the most important source of industrial trouble might easily come back with the reply — demarcation rows. Yet in all the 5¼ million working days lost through stoppages, only 35,000 were due to shipbuilding demarcation troubles. The time lost went up by 1,778,000 working days compared with 1958, but this increase was more than covered by the prolonged struggle in the printing industry.

Coal mining continued to suffer numerically the most strike damage although the number of outbreaks declined from 2,639 in 1958 to 2,085. The motor car industry doubled its labour trouble last year; the number of men involved in strikes there rose more than 100 per cent to 157,600. Days lost went up almost three times, from 160,000 to 465,000 and the number of disputes in which this occurred was up by 51 stoppages to a total of 135 in 1959.

Shipbuilding, civil engineering and building enjoyed an improvement, with numbers of working days lost declining.

Perhaps the most significant event of last year in labour affairs was that there was an increase of only just above one per cent in full time weekly wage rates. There was, however, some increase in the amount of overtime being earned so that earnings have been advancing much faster than have rates.

The small rise of 1 per cent in wage rates contrasts with 3½ per cent in 1958, 5½ per cent in 1957 and 7¾ per cent in 1956.

Just Isambard and EIS

Fascinating as are the queries and commissions Engineering Information Service engage in, they tend to lack the uproarious skylarking of William, the perennial schoolboy hero.

Like other famous figures of fiction, William currently appears in his own strip cartoon, in the magazine *Woman's Own*. And for the last issue in January of *Woman's Own*, EIS was asked for a suitable picture of Brunel's famous Saltash bridge.

Not, as may have been feared, that William was planning another Tay Bridge disaster: the schoolboy horror was bridging a stream on a pay-as-you-cross basis in order to raise pennies for the tuck shop.

Nomadic Nuclear Power

The organic moderated reactor is one of two systems chosen by the Ministry of Transport for tenders in connection with a nuclear ship. The same reactor would be suitable for generating power in remote areas.

Plutonium has an evil reputation because it is used in hydrogen bombs. Yet plutonium, produced in Britain's nuclear power stations, is likely to revolutionise atomic power production throughout the world. Plentiful supplies of plutonium for use in the enrichment of reactor fuel instead of uranium 235, which can only be obtained by a costly concentration process, may lead to lower operating costs in nuclear power stations, and make nuclear propelled ships an economic proposition.

Another material, still under development, which may raise the efficiency of future atomic reactors is the metal beryllium; when used as a canning material for fuel elements, its heat resisting qualities and low interference to the passage of neutrons should allow higher operating temperatures and therefore greater outputs of energy.

A third substance is terphenyl (by-product in the extraction of diphenyl from benzine) for which few practical uses have yet been found. Terphenyl is a waxy solid, which begins to melt at about 140° F (60° C). Its flashpoint is 380° F; it will burn at 430° F; boils at atmospheric pressure around 717° F, and ignites spontaneously at something over 940° F. It is non-corrosive, does not become radioactive and cannot be ignited at all in an atmosphere containing less than 15 per cent oxygen.

OMR AT SEA

Terphenyl has been chosen to act as moderator and coolant combined in the organic moderated reactor (OMR) to be produced by the Hawker Siddeley Nuclear Power Company Limited. Its high boiling point means that the normal operating pressure of the reactor will be relatively low, so that lighter construction, with standard pumps, valves and pipe fittings, can be specified. Its non-corrosive properties will allow mild steel and other relatively cheap materials to be used. Its immunity from induced radioactivity will cut down the amount of heavy shielding and the number of costly remote control mechanisms that are required for operation and maintenance.

It is seldom considered that the spread of industrialisation to areas remote from sources of conventional fuel will further increase the amount of oil consumed by ships carrying fuel and raw materials to distant factories. Ships may well be among the first to make use of the new source of energy—especially large fast cargo liners operating on long distance runs with few convenient bunkering ports. The high freight rate earned by these ships will allow them to repay more quickly the increased capital cost of a nuclear power plant. Such a plant also weighs less than conventional machinery and bunkers, so that the relative carrying capacity of a nuclear ship will be greater.

A recent study of nine ship designs varying between 500 ft and 550 ft in length and with speeds of 18 to 22 knots, trading between Europe and Australia, showed that in each case the initial cost of an OMR-powered vessel would be just over 40 per cent more than that of an oil-fired ship, while operating costs would at present be only slightly higher. In the future, an expected reduction in the cost of terphenyl and the use of beryllium or sintered aluminium powder (SAP) as a canning material, with plutonium for fuel enrichment, should reduce both the capital outlay and the operating costs to a point where overall profits on such a ship (after allowing also for interest on the capital sum involved) will be higher than on a conventionally powered vessel. (ENGNG., 16 Oct. '59, p. 342).

A typical marine reactor, suitable for a 20,000 s.h.p. power dry cargo liner, would have a maximum heat output of 64 MW from a core 5 ft high by 5·75 ft diameter. There will be 7·9 tonnes of uranium oxide fuel, enriched 1·6 to 1·8 per cent with uranium 235 or plutonium and arranged in 294 bundles of 19 rods. Maximum operating pressure will be 90 lb per sq. in with a reactor outlet temperature of 646° F (341° C). Steam at 630 lb per sq. in and 620° F will drive conventional turbines. At full power, the system will have to be replenished with 1,950 lb of make-up terphenyl every day.

CONTROL

The control arrangements will have means for regulating the reactor heat output according to varying steam demands. While the ship is on passage, the heat output will be set by the reactor operator; but while manoeuvring in harbour, very rapid variations in steam requirement will be met by maintaining a constant reactor heat output and passing any excess steam to a small dump condenser operating at atmospheric pressure. Special design requirements for ship reactors are the following.

Reactor dimensions should cause the minimum encroachment on cargo space and allow for a gap of at least 15 ft between the wall of the containment vessel and the ship's side. This virtually eliminates the risk of damage to the reactor (with the possible escape of fission products) in the event of a collision.

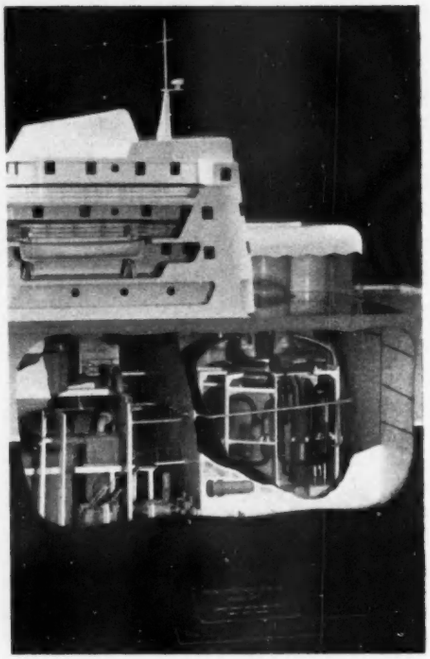
The reactor should be designed for easy maintenance. The low induced radioactivity of terphenyl allows maintenance work to be carried out, even in the primary circuit, without shutting down the reactor. Primary shielding of the reactor core consists of steel and water layers; secondary shielding outside the containment vessel makes it safe for maintenance or repair parties to enter the reactor room even if there has been an accidental leakage of fission products from the fuel elements.

The power plant must have long endurance. Assuming that a cargo vessel of this sort would spend 40 per cent of her life at sea and 60 per cent in harbour, a single charge of fuel would last for approximately two years and take about two weeks to renew. In practice it will be more convenient to replace a few fuel elements at the end of each round trip This procedure will also reduce fuel costs by about 10 per cent. At home ports, terphenyl will be brought to the ship in insulated tanker trucks which will keep it sufficiently warm to remain liquid; at overseas bunkering ports it will be embarked in drums.

PROFITS

Hawker Siddeley believe that an OMR-powered cargo liner of 12,600 tons deadweight with a speed of 20 knots could be built within five or six years for a total cost of £3,975,000 (of which only £820,000 would be spent on the reactor). Insurance, depreciation, interest on capital and other fixed costs would today amount to £697,100 per annum, with fuel and moderator supplies at £103,000 per annum. On this basis, profits per ton of cargo carried between Europe and Australia via the Cape of Good Hope could be about 88 per cent of those on an equivalent conventional ship. Advances in technology over the next few years, however, are expected to reduce the initial cost of a nuclear vessel by 20 per cent and subsequent fuel costs by as much as 40 per cent with corresponding improvements in her profitability.

Since no oil fuel would be carried in the double-bottom tanks of such a ship and the reactor assembly would have a higher centre of gravity than conventional machinery, the overall



centre of gravity of the vessel would be raised. She would therefore have to be broader in beam to compensate for any loss of stability from this cause. The actual dimensions proposed are: length 528 ft 6 in, beam 84 ft 0 in, depth 53 ft 6 in, maximum draught 32 ft 9 in.

POWER FOR REMOTE AREAS

The 70 MW(e) unit proposed for use in small power stations will take approximately four years to manufacture and assemble at an estimated cost of £45 per kW sent out. The station, including workshops and offices will cover an area of about 25,000 sq. ft and require a total staff of 30. Working continuously at maximum power the reactor will consume a full charge of fuel in about 11 months. It will operate at a maximum fuel can surface temperature of 450° C (840° F) and a reactor pressure of 100 lb per sq. in absolute. At that pressure terphenyl will not boil below 510° C.

The coolant will leave the reactor at 340° C (645° F) and will be circulated by electrically driven pumps through two parallel and identical heat-exchanger systems with evaporator and superheater sections. Here steam at 600 lb per sq. in gauge and 327° C (620° F) will be generated to drive conventional turbo-alternators with an electrical output of 20 MW.

A processing plant deals with the slow decomposition of terphenyl—forming gases (mainly hydrogen) and polymers (the linking of some of the molecules into chains)—under high temperature and nuclear radiation. Polymerisation increases the viscosity of terphenyl so that additional power would be required to pump it. The polymers are therefore removed in a still which will also remove any radioactive particles that might escape into the coolant from a leaky fuel element. The gases are extracted by passing the coolant through a tank under partial vacuum in another part of the plant. About 2,000 lb of fresh terphenyl must be added to the system every 24 hours when operating at full power to make up losses.

The fuel assembly consists of 294 bundles of 19 half-inch uranium oxide rods clad in stainless steel. The OMR has a negative temperature coefficient, a rise in temperature producing a corresponding fall in reactivity. Normal control is by means of 19 boron steel rods which are inserted from below so as to permit unrestricted movement of the fuel handling equipment above the core. In emergency, the rods are positively inserted by long steel springs, shutting the reactor down.

Safety in the Air Begins on the Ground

The increased work loads put on pilots of civil jets are a danger to safety. Greater effort is needed to improve design of ground aids and aircraft controls and instruments.

Safety in the air begins on the ground. It begins when design produces the smooth operation of the control system made up of pilot, aircraft, and ground aids.

Any one of these three can endanger the safe operation of an aircraft. But because of his flexibility of operation the human pilot can often compensate for shortcomings of his aircraft or ground aids. So much so that some accidents explicitly attributed to human error in the cockpit are really brought about by external factors beyond his control. The pilot is the most important link in an optical control loop, and his efficiency can be seriously impaired by overload or by poor information. For safety in the air, therefore, the aircraft and the ground aids must be designed to allow the pilot to exercise his control function under optimum conditions and in accordance with reliable information.

An aircraft is generally safe in the air. Most accidents occur during take-off or landing. Because of this the safety of any new pattern of flying must be examined in the light of the work load it presents to the pilot during these phases. The growing use of jet aircraft by civil airlines is a case in point. Their higher speeds give the pilot less time to think and their increasing passenger complement brings greater responsibility and increased anxiety. All of which adds up to intensified work load for the pilot. The rate at which accidents can increase on the introduction of jet aircraft is illustrated by the experience of the USAF in 1953. Then the accident rate for jet aircraft due to visual errors during landing was over seven times greater than for propeller driven aircraft.

Here is how Captain B. O. Prowse, a pilot of 27 years experience, has described the situation. "Until now the speed of operation of aircraft has been compatible with the speed of computation of the human brain that is governing the pilot's reactions. . . . Now, however, with aircraft such as, for one instance, the B707, we have arrived at the state where this compatibility just about ends. The human pilot is approaching a stage beyond his design capabilities." When such a stage is reached, a slight additional overload can produce disastrous results. Captain Prowse's comment and other points in this article have been taken from papers presented at the symposium on Operational Problems of Take-Off and Landing held by the Royal Aeronautical Society in conjunction with the Commonwealth Advisory Aeronautical Research Council.

Critical features of jet aircraft include the changed performance characteristics, higher approach and landing speeds, and differences in approach attitude. In addition, the absence of propellers to create thrust reversal, together with the slow die-away of jet thrust, make it more difficult to stop a jet aircraft—an undesirable feature when a take-off has to be abandoned and the aircraft brought to rest on the remainder of the runway. Such problems are increasing because of the marked rise in aircraft weight. The pilot has to use much more of the runway in order to get off the ground. He has a much narrower margin of error. So much so that serious thought is being given to the use of arrestors such as are used on aircraft carriers. Systems based on hook and cable techniques and on nylon nets have been tried and are being developed. They would be of service both for landing and for abandoned take-off.

One of the most difficult problems in take-off with jet aircraft is the judgment whether the acceleration on the ground run is adequate. The combination of the thrust-speed characteristics and the temperature sensitivity of jet engines present particular difficulties. The need for further instrumentation is indicated.

At night, the problem of sensory confusion between acceleration and climb, which has caused many accidents, can be accentuated by the greater acceleration, higher speeds, and, in some aircraft, lack of control "feel," in the new generation of jets.

Aircraft with jet engines clustered in the area of the tail pose the additional problem that loss of thrust on one engine is not immediately recognised by asymmetric behaviour of the aircraft, as it is when wing-mounted engines are used. An engine thrust indicator is called for.

Automatic landing systems have advantages of offering increased safety, economy, and strategic value. At present, such systems have reached a stage where they are becoming ready for evaluation as a component in the overall airway operations system. In the United States the Bell system is being applied experimentally to all types of aircraft. Its special claim is that it is able to handle various types of aircraft with no special airborne equipment beyond that already required for present automatic approach. An accurate auto-follow radar and a ground computer monitor the aircraft's approach and indicate errors by coded signals passed over the aircraft's instrument landing system voice channel; normal automatic coupling to the auto-pilot is used to manoeuvre the aircraft on to its correct trajectory.

In Britain the Blind Landing Experimental Unit of the Royal Aircraft Establishment at Bedford has developed a system based largely on conventional automatic approach equipment and standard instrument landing systems. At a certain point in the approach, azimuth guidance is taken over by cables embedded either side of the runway. Then altitude control is taken over by a radio altimeter in the aircraft. An automatic throttle control device is incorporated to provide the necessary speed stabilisation and drift compensation.

A basic problem that has to be solved with such automatic systems is to decide the steps to be taken to prevent system failure, and to decide the role the pilot has to play during landing. Duplication of equipment seems part of the answer. But the degree of monitoring or control exercised by the pilot during an automatic landing is a topic for further research: more knowledge is required of the pilot's attitude to automatic systems.

Unfortunately, the cost and complexity of automatic landing systems means that even when they become operational they will be confined to a few airports. Pilots will still have to make non-automatic landings. Thus it is still necessary to improve instrument displays and to understand better the difficulties inherent in landing and take-off. Better control of airspeed is essential; and this points to the need for improved indication of airspeed (such as the auditory system developed by the RAF Institute of Aviation Medicine) or for automatic speed holding devices—which would allow the pilot to concentrate on control of the glide path and azimuthal heading.

Such instruments are not easy to get into service. For example, one approach problem that has not yet been solved is the ease with which the standard altimeter is misread—often with disastrous results. Although the requirements for a satisfactory altimeter were set out in 1949, a completely suitable unit has not yet become available. Most aircraft are still fitted with the old three-pointer instrument.

Visual indicators at airports play a considerable part in lowering accident rates during landing. The use of multiple cross-bars improve guidance in the vertical plane and on a modern runway equipped with a precision approach aid and a five-bar cross-bar system, the accident rate in civil operations due to visual misjudgments is probably less than 2 in 1,000,000. At runways with abbreviated or no approach lighting systems, the accident rate where conditions are particularly difficult may exceed 1 in 10,000.

On coming in to land, guidance in the vertical plane is the most urgent problem. A pilot can detect a small lateral error and see in a few seconds whether it is decreasing or increasing. But he can detect a height error only if it is large and he will not know for many seconds whether it is increasing or decreasing. In tests made on military jets, it was found that the angle of descent in purely visual approaches varied from 1·4° to 5·4° and that the touch-down points were spread over a distance of 2,000 ft. Lateral errors were very small.

Some weather conditions, notably shallow or stratified fogs, are especially treacherous in that the sudden decrease in visual range on entering the fog layer looks like a change in the angle of descent in a nose-up sense. Pilots therefore tend to steepen their angle of descent when they enter the fog. Demonstration of this effect to a pilot with a simulator can teach him to guard against it. In fact, a considerable contribution to safety can be provided by demonstrations on the ground—by films and simulators—of the limitations of visual guidance in all visibilities.

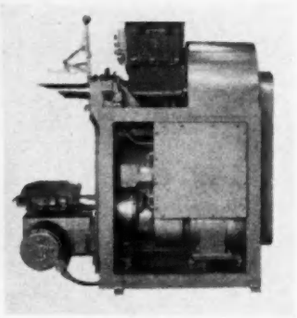
WEIGHER

For Sack and Bag Filling

A NEW combined weigher and bag filler has been developed particularly for use with "difficult-to-handle" powders.

The unit, which has been approved by the Board of Trade Standards Department for weights and measures acceptance, is designed to fit under a hopper. In the feed inlet is an agitator to prevent the material arching and to keep an even flow.

Valve sacks are used (that is, those having a closed top to prevent the powder from flying) and up to three per minute can be filled. The range of weights is from 28 lb to 112 lb. As shown in the illustration a bag settling vibrator can be fitted enabling minimum size bags to be used. The powder is screw fed through the spout, there being two rates of feed for each operation. The first 95 per cent of the amount is fed at high speed and then the last 5 per cent very slowly to give exact weight. Finally a reverse mechanism clears the spout. The high and low speed motors are interconnected by an electronically controlled clutch



which allows infinitely variable adjustment of the feed rates. The speeds are controlled by a potentiometer on the front panel.

Also on the front panel are the calibration controls to select the weight required. The bags are held in position by a hand operated toggle clamp. The machine is very compact requiring a floor area only 2 ft 6 in deep by 18 in wide. *Richardson Scale Company Limited, Albert Street, Bulwell, Nottingham.*

HONING MACHINE

Up to $2\frac{5}{8}$ in Diameter

NOW available in this country is the American Sunnen honing machine for accurate work on through or blind holes.

The capacity of the machine is from 0·1 in diameter up to $2\frac{5}{8}$ in, and mandrels and stones can be supplied for holes up to 18 in long. Types of work include blind holes, through holes, keyed bores and some forms of splined bores. It is claimed that the machine is specially suited for honing hydraulic sleeves where the bore may be broken by a number of ports, as there is said to be no "washaway" where the port runs into the bore. "Tandem" bores can also be produced with great accuracy.

The three bearing surfaces are unequally spaced round the mandrel so that it is claimed the stone will not follow or generate an out-of-round pattern. Two rigid metal guide shoes locate the component and the stone forms the third surface. Long guide shoes are provided to bridge any bow or irregularity in the bore to maintain a

true axis over the entire length of the hole being machined.

Stones are precision graded and it is claimed that a predetermined microfinish can be obtained by choice of grade which will be consistently reproduced. *Thomas Mercer Limited, Eywood Road, St. Albans.*

INDICATING LAMP

Built-in Test

A WARNING and indicator lamp now available includes a built-in test facility, as well as a dimming control.

The lamp unit measures $\frac{1}{8}$ in overall diameter which allows a centre to centre distance on the panel of $\frac{1}{4}$ in. It is interchangeable with earlier types of warning light made by the same firm.

When used as a normally "off" warning indicator the filament can be checked by pressing the transparent plastics lens which lights the lamp through auxiliary contacts. The dimming adjustment is obtained by rotating the bezel through 90°, the dimming position being indicated by a raised pointer moulded on the lens. Red, green, amber, blue, and clear lenses are available.

There are three screw-type terminals at the rear with protection against the ingress of dust. Operation is safe in ambient temperatures up to 50° C. Replaceable bulbs can be supplied for 6, 12, or 28 V working potential. *Dowty Nucleonics Limited, Aircraft Electrics Division, Tewkesbury.*

SPRAY GUN

For Vitreous Enamel

LOW pressure spray guns have been introduced for applying vitreous enamel coatings with greater ease and less skill.

Chief advantages claimed for these guns are economy in the amount of enamel used; that a fine coat can be applied that is far less brittle after firing; and that less skill is needed by the operator. Also when spraying the interiors of bowls and hollow objects there is less "bounce" of the enamel, which can be a serious problem when normal pressures are being used, and surface defects are avoided.

Two models have been produced: the L1900 (illustrated) and the L200. For the former the best results are obtained with fluid pressures varying between 5 and 12 lb per sq. in and with an air pressure of 25 lb per sq. in. With the L200 a fluid pressure of 5 lb per sq. in is desirable with an air pressure varying from 25 to 50 lb per sq. in. The material used during tests at the maker's works was a standard cover coat enamel

having a specific gravity of 1·34.

A parallel development was that a great increase in speed for the mottling process was also obtained using the L 200 gun. This process has always been regarded as time consuming. A fluid pressure of 5 lb per sq. in and an air pressure of 8 lb per sq. in were used. The guns have been developed in conjunction with Ferro Enamels Limited. *Alfred Bullows and Sons Limited, Long Street, Walsall, Staffordshire.*

SOUND LEVEL METER

Transistorised

A PORTABLE transistorised sound level meter has been introduced for general use.

The unit comprises a crystal microphone and impedence matching circuit, two attenuators, a high gain amplifier, weighting networks and an indicating meter. The attenuators are adjustable over the audio range from 24 to 140 db. The three weighting networks simulate the frequency response of the human ear to low (40 phon) medium (70 phon) and loud (100 phon) noises.

The instrument can be used at any angle, either free standing or held in the hand, or it may be left in the carrying case simply with the microphone raised. As the transistors do not need a warming-up time, instant readings can be taken. One set of batteries lasts for about 60 hours. A jack plug socket is provided for connection to a frequency analyser.

Shown also in the illustration is the calibrator unit which produces a wide band noise of 90 db at a distance of

8 cm. Calibration to an accuracy of ± 1 db can be made without need for an anechoic chamber. In the calibrator are small balls which fall on an anvil and rebound to a diaphragm to produce the standard noise. The frequency is centred on 1,500 c/s. *Dawe Instruments Limited, 99 Uxbridge Road, London, W5.*

OIL-FIRED BOILER

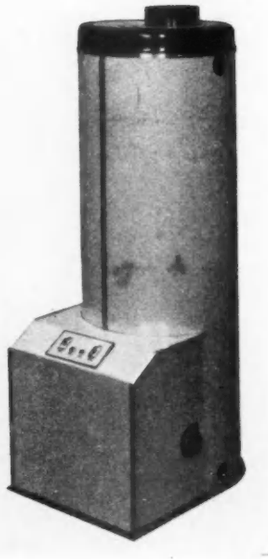
Packaged Unit

NOW being made is an oil-fired packaged boiler, the "1970," with a guaranteed combustion efficiency of 83 per cent.

The unit has an output of 40,000 Btu per hour and incorporates a "Money-Miser" device that gives audible warning if the efficiency falls. It is claimed that this is the first boiler to have such a safeguard.

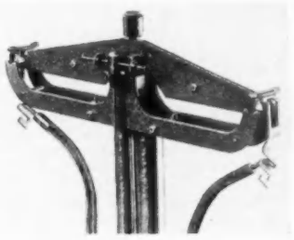
The burner is of American origin and is fan assisted to avoid chimney draught problems. As a packaged unit it is easily installed and it requires little space as the overall dimensions are: height 49 in., width $17\frac{1}{2}$ in, and depth $23\frac{1}{2}$ in. An electrical supply of 200/240V is required.

The boiler presents a smooth finish and is claimed to be extremely simple to operate. All working parts are easily accessible for maintenance. The tappings for the return water pipes are placed very low. *D. E. Stuttard Limited, Jack Bridge Mill, Colden, Hebden Bridge, Yorkshire.*



BALANCE

Quick Weighing



THE first of a new series of balances is designed for quick weighing and robustness.

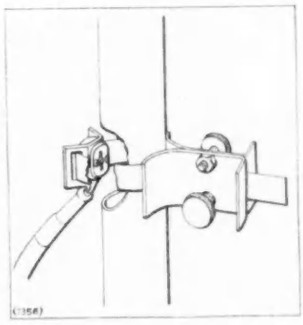
The Minor has a capacity for 250 gm and a sensitivity of 2 mgm. Single limb bows carry the pans for unimpeded operation: an inclined scale rises with the pointer, thus facilitating readings and avoiding parallax; the stirrups have been redesigned to protect the knife edges and a new design of pillar allows quick assembly.

The arrangement of the agate bearings has been changed and they are held in place with screws. When the beam is arrested all the bearings are relieved instead of only the centre one, making for longer life. By placing the poising nuts near the centre they cannot be so easily damaged and moreover the length of the whole is reduced. When not in use the beam is located by two central slots in the arrestment beam and kept horizontal by two locked screws. The slots are deep enough to prevent the beam being accidentally dismounted. The stirrups are single piece pressed metal type with double hook.

Twin pillars supporting the arrestment beam are mounted on a rectangular plate held in position by two nuts positively located beneath the base. Between the pillars passes a plated rod which carries the central bearing plane, the scale and the cam plate. The pans are 4 in diameter made of plastics, and have adjustable grub screws to prevent swinging when the balance is arrested. The base is moulded plastics measuring 15 in by 6 in. The overall height is 13½ in. *Griffin and George Limited, Ealing Road, Alperton, Wembley, Middlesex.*

THERMOCOUPLES

For Use on Pipes



THERMOCOUPLES are now available for taking spot checks on pipes of widely varying diameters.

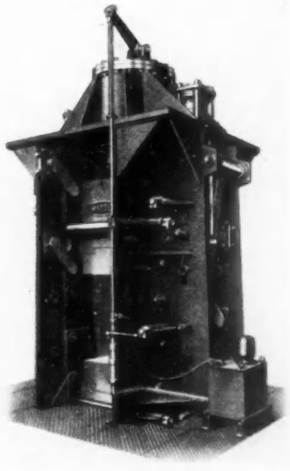
The pipe thermocouples are suitable for temperatures up to 300° C (575° F). They are attached to the pipe by a stainless steel ribbon that passes through the metal eyelets in the thermocouple head and is brought round the pipe and securely fastened by the thumb screws in the clamp. The element is thus held firmly spring loaded against the surface and can be removed at any time. For permanent installations the ribbon would be trimmed off flush with the clamp.

For short tests the couples are normally used in conjunction with a portable indicator but for permanent installations in buildings, as for instance on the central heating pipes of a building, several are placed at intervals on different floors, in different rooms, or in different pipe runs and connected to a multipoint indicator that will give coverage of all parts of the system.

The great advantage offered is that direct readings from the actual heating source of each room can be obtained at a central point to keep a check on the operation of the whole system. Alternatively the thermocouples can be used for short duration tests in industrial plant, or following the installation of new equipment. They are relatively inexpensive and require little space, so they can be used wherever wanted. *Cambridge Instrument Company Limited, 13 Grosvenor Place, London, SW1.*

COUNTERBLOW HAMMER

For Drop Forging



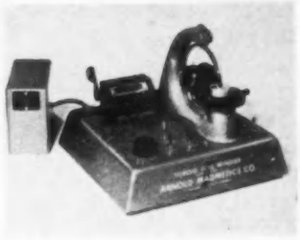
A REVISED design of counterblow hammer has been introduced to meet the need for arduous drop forging.

The counterblow hammer (in which the anvil rises to meet the falling tup) is useful where ground loadings and vibrations have to be kept down and transport of a heavy anvil would be difficult. There are ten sizes in the range with blow energies from 43,500 ft-lb to 290,000 ft-lb. Maximum strokes range from 3 ft 4 in to 5 ft 2 in and the space between the slides from 2 ft 4 in to 4 ft 5 in. The maximum die lengths are from 4 ft to 9 ft 10 in. Compressed air or steam can be used for operation though the former is recommended. Working pressure is between 6 and 7 atmospheres.

A special feature of the design is the compensating gear for the belt couplings that link the tup and the moving anvil. The two pulleys are fitted with hydraulically linked compensating cells with bellows sealed expansion joints. An indicator is fitted to show the state of adjustment and a considerable differential movement can be tolerated before correction is necessary. *B. and S. Massey Limited, Openshaw, Manchester 11.*

COIL WINDING MACHINE

For Toroids



THE Arnold coil winder AMC-4 is a compact machine for winding toroids from 4 in outside diameter to 0·235 in inside diameter.

The machine will handle wire sizes from AWG26 to AWG44 (approximately 27 s.w.g. to 50 s.w.g.) with a winding rate of 1,500 turns per minute. The maximum toroidal height that can be managed is 1·5 in. Dimensions are 11 in by 11 in by 2½ in high; power is supplied by a $\frac{1}{75}$ h.p. motor. A mechanical counter on the base has a maximum counting rate of 6,000 per minute and an additional electronic impulse counter one of 1,500 turns per minute. Reset in both cases is manual.

It is stated that the operator can install the core, load the ring and start winding in less than 45 seconds. A continuous range of tension adjustment is possible from a single point. Nylon inserts protect the inside of the coil from damage by the rotating ring, so that accurate centring is not needed. The operator has precise control over the amount of wire loaded on the ring (using the mechanical counter) and so waste is reduced. The rollers are cushioned in rubber for silence.

The winding rings are made of alloy steel and will spring to give an opening up to 2 in. Beryllium copper sliders keep the wear down to negligible proportions. Guide blocks are adjustable and by moving them away from the coil a scrambled low capacity winding is obtained. In special cases it is possible to wind coils with internal diameters as small as 0·18 in, but this is not recommended for production work. *Sylvan Ginsbury Limited, 8 West 40th Street, New York 18, NY, USA.*

SLEWING JIB CRANE

Electrically Operated

FOR lorry loading, an electrically operated crane has been made with slewing and travelling motions.

The first model was for handling 1,000 bales of wool a day with only two men—one on the lorry and one driving the crane. Porters brought the bales on trolleys.

All the crane controls are duplicated so that the driver can choose whichever side gives him the better view. A limited amount of travel on rails allows the crane to be positioned according to loading requirements.

The lift height is approximately 18 ft and the operating radius approximately 10 ft. The crane is fitted with two-speed motors giving lifting speeds of 28 ft per minute and 85 ft per minute, and travelling speeds of 12 ft per minute and 40 ft per minute. The jib is capable of slewing through 90° in 6 sec and can rotate through a full circle.

For safety and protection, all the operating equipment is enclosed in a steel casing in which are panels to provide access. Bolted construction was employed throughout this version. The driver stands on a built-in platform reached by an access ladder. Current is supplied to the crane by a flexible cable from an overhead power point. *Taylor Stoker Company Limited, 189-191 Drummond Street, London, NW1.*

BLIND RIVETING TOOL

Air-Hydraulic Action

THE German Gesipa tool for blind riveting is now on the market in this country.

The tool operates from a compressed air line at 80 to 100 lb per sq. in and is said to fix several hundred rivets per cu. ft of air used. Between 25 and 30 can be fixed per minute. Rivets up to ¼ in diameter can be used.

The loose mandrel of the rivet is placed in the nose piece of the gun, and the tool with the open head of the rivet protruding is inserted into the drilled hole. A pull of the trigger releases air into the pressure chamber within the gun, drawing in the mandrel and so forming the rivet.

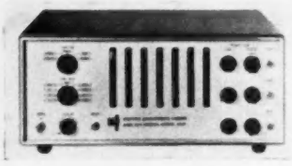
Chief claims are that it has a hydraulic chamber in the body that converts the pneumatic action to a hydraulic one; that it weighs only 2 lb; that the head can reach awkward corners; and that only a light air line is needed so that the gun can be operated by female labour. Rivets formed by this process follow the shape of the workpiece closely and so improve the strength of the joint. *Trend Industrial Equipment Limited, 77 and 95 Dudden Hill Lane, London, NW10*

COUNTER-TIMER
Up to 10 Megacycles

THREE new CMC counting and timing instruments have been introduced covering from d.c. to 10 Mc/s; all are fully transistorised.

The first is a universal instrument for counting and timing and the other two are frequency/period and time interval meters. Power consumption of the first, model 727A, is 35W or about $\frac{1}{10}$th the requirements of an equivalent unit using valves. The weight has also been substantially reduced to only 27 lb. All components run below their maximum rating to give long life and stability and the instruments are light enough for airborne operations and small enough to fit American explosion-proof housings.

The model 727A combines the functions of a counter, time interval meter, and frequency/period meter. It performs five basic functions selectable by a switch on the front panel. The input circuitry has been designed to exploit remote control without special regard to cable lengths or impedence matching.



The instrument consists of three input channels, a special decade count-down time base, timer that eliminates the need for a divider adjustment, and a series of plug-in transistorised decade counting units. Output information from each decade will operate digital printers, punches, in-line readouts and other data processing equipment. Readout is available in either the standard vertical numeral panels as illustrated or with the in-line Nixon version.

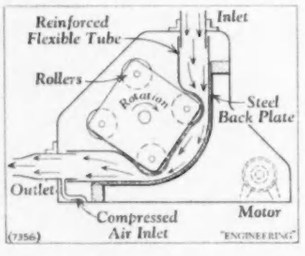
The universal counter timer covers the range from dc to 10 Mc/s for frequency; 0·1 μ sec to 10^7 sec for time interval; and 0·1 μ sec for period. Frequency converters are available for higher frequencies. Accuracy is ± 1 count $\pm$ oscillator stability. Sensitivity is 0·25V rms; input impedence 25k ohms per volt. *Ad. Auriema Inc., 85 Broad Street, New York 4, NY, USA.*

SOLIDS PUMP
For Fluidised Powders

IT is claimed for a new solids pump that it will convey any powdered material that can be made fluid by air.

The Squeegee solids pump consists of an open length of flexible tube, a rotor with four equidistant rollers, and a compressed air inlet. The rollers progressively squeeze the tube and force the material along. The compressed air then enters and conveys the material the rest of the way. Back leaks are prevented by the pressure of the rollers. In this way it is claimed that only 10 per cent as much air is needed as in a conventional system. A simple filter sock is sufficient to separate the dust from the air.

Two sizes of tube are made, 2 in and 3 in. A 1 h.p. motor is required. The pump is available with or without a compressor and is supplied complete with the requisite length of conveying pipe. Measuring only 17 in wide by 44 in long by 37 in high, it is a compact unit.



Conveying rates are up to 8,000 lb per hour depending on the material, and vertical lifts of up to 70 ft with total conveying lengths of up to 200 ft can be achieved under normal working conditions. From 15 to 20 cu. ft of air per minute is an adequate supply for most installations.

The flexible tube has a life of as much as 1,000 hours and can be replaced in a matter of minutes. The pump does not sustain any damage in the event of the stock running out and can be safely allowed to run dry. The small quantity of air used means that the powder is discharged with very little turbulence. *Henry Simon Limited, Stockport, Cheshire.*

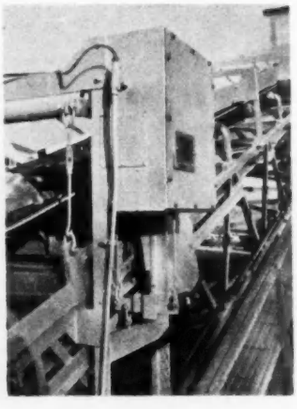
BELT WEIGHER
One-Half Per Cent Accuracy

A CHIEF claim for the SV Weightometer belt weighing machine is that it can be fitted to any existing installation with a minimum of alteration to the structure.

The unit will fit on horizontal or inclined conveyors having either flat or troughed idlers, and will totalise the weight of material passed. A mechanical integrator continuously multiplies the varying load on the conveyor by the speed variations of the belt to give the passed weight. The machine can be supplied to suit any conveyor capacity or belt speed.

All types of instrumentation can be supplied with the machine, both electronic and pneumatic. The recorder can be remotely sited from the weigher. Advantages include the simplicity of design and the low headroom needed for installation.

The accuracy is within $\frac{1}{2}$ per cent of the true weight passed when the conveyor is running at full capacity. Extreme and rapid fluctuations in the loading can be accounted for and so can considerable changes in the speed of the belt.



The illustration shows the Weightometer set in an inclined conveyor and shows the simplicity of the arrangement. Experience has shown that long trouble free life can be expected. *Merrick Scale Manufacturing Company Limited, Albert Street, Bulwell, Nottingham.*

PLANO-MILLER
For 100 Ton Components

A PLANO-MILLER said to be the largest yet built in Britain will take workpieces weighing 100 tons and measuring 35 ft 6 in long by 12 ft wide by 9 ft 6 in high.

The table and milling head traverse are controlled electronically to provide an infinitely variable range of feeds. Further electronic equipment is fitted to give the operator the facility of "steering" the cutter by remote control round any shape of workpiece. This arrangement permits continuous metal removal with a substantial reduction of machining time on any component, irrespective of its contour. Steering is effected by movements of a car type handwheel which is fitted in each of three control stations. The path steered by the operator automatically determines the speed and direction of the cutter traverses.

Four milling heads are provided each powered by a 100 h.p. motor. Face cutters up to 3 ft diameter can be used. The diameter of the spindles over the splines is 8 in. The maximum width between the columns is 15 ft and the maximum distance between the centres of the horizontal spindles and the table is 7 ft.

There are 16 changes of spindle speeds ranging from 10 to 200 r.p.m. Table traverse is 37 ft 6 in when the four sections are bolted together. Table and milling head feeds are infinitely variable from 1 to 50 in per minute; vertical and horizontal power traverse is 18 in per minute and table rapid traverse is 180 in per minute. All motions are driven by separate motors. *Kendall and Gent Limited, Victoria Works, Gorton, Manchester 18.*

CENTRIFUGE
For Bituminous Mixture Testing

A NEW centrifuge apparatus is now on the market for measuring the surface capacity, including absorption, of coarse and fine aggregates used in bituminous mixtures by the kerosine equivalent.

The apparatus can also be used to determine an index which indicates the relative particle roughness or degree of porosity. A bowl of glass fibre is mounted on an aluminium base in which is the driving motor. Two centrifuge cups each $2\frac{13}{16}$ in high and $2\frac{1}{16}$ in diameter are held in a two-place head arrangement within the protecting bowl. A glass fibre lid completes the enclosure of the moving parts.

The switch for controlling the motor is incorporated in the base, which is designed for bench mounting. Spare aluminium centrifuge cups are available, supplied complete with perforated base plates.

In addition to the power driven model, a similar apparatus for determining the centrifuge kerosine equivalent is available for hand operation. A crank drives the centrifuge through step-up gearing to give the necessary speed. The test was originally developed by the Materials and Research Department of the California Division of Highways. *Soiltest Incorporated, 4711 W. North Avenue, Chicago 39, Illinois, USA.*

PETROL ENGINE
General Purpose Unit

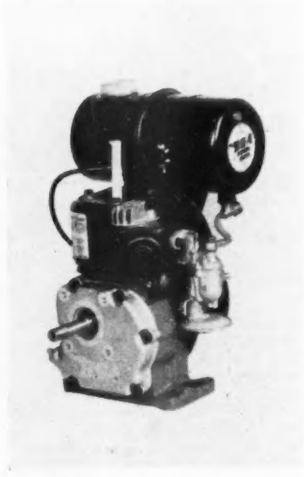
SERIES 90 petrol engines are small lightweight units developing 1·9 h.p. for a dry weight of 23 lb.

The range consists of a basic engine with a number of interchangeable crankcase covers to allow for a variety of uses. The crankshaft can be either vertical or horizontal. Illustrated is the 90C model for close coupled usage and with the large capacity petrol tank.

The engines are over-square with a bore and stroke of 54 mm and 38 mm respectively. The capacity is 87 c.c. and the power developed 1·9 h.p. at 3,600 r.p.m. The main body is cast iron but light alloys have been used elsewhere. The engine runs on the four stroke cycle.

Normal lubrication is by splash with an additional screw feed for the vertical shaft model which has the flywheel bearing of steel backed white metal. In this model the end cover acts as the sump.

The crankshaft is a steel forging and the aluminium connecting rod runs direct on the pin at the big end. Governing is by an airflap operating in the stream of the cooling fan. *B.S.A. Motor Cycles Limited, Power Unit Sales Division, Birmingham 11.*



Proof is in the Heating

Apart from Calder Hall type reactors, which have proved difficult to sell to private industry at home or abroad owing to the large unit size, British reactor manufacturers have no working prototype of other reactor systems. Chances are good that either an organic moderated or a boiling water reactor will be built under the marine reactor programme (see Special Article, page 190 of this issue), but firms developing competing reactors will have to find a suitable application on their own. Process heat generation offers limited opportunities for a first installation.

Small Benefit to Purchaser

A typical reaction to the prospect of nuclear process heat tends to be a detached fascination with the novel heat source combined with a remarkable lack of buying enthusiasm. Anybody attempting to sell process-heat reactors will enter into negotiations from a weak position. Heat tends to make a minor contribution to the cost of the finished produce; hence the producer will derive only slight benefit even from the most drastic reductions in heating cost. The total elimination of heating would reduce the price of products by only ½ to 5 per cent in most cases. As a result, the greatest beneficiary of the sale of a heating reactor would be undoubtedly its manufacturer, and it is understandable that process heat users have shown no great enthusiasm for financing the development of suitable reactors. The attitude in response to a questionnaire circulated by the USAEC among users of process heat was uniform: show us a prototype, then we can talk about it. It is clear that without a working prototype the prospect of selling a commercial reactor is slim, and at least part of the first installation's cost will have to be borne by the nuclear industry.

Applications Restricted

At first glance the process-heat business appears to be far more lucrative than electrical power generation. A study by the American National Planning Association showed that only about 15 per cent of energy consumption is in the form of electricity, the remaining 85 per cent being distributed among transportation, domestic and industrial space heating and process heat. There is little hope that nuclear heat will ever furnish a significant proportion of domestic consumption: the load is scattered and seasonal. Concentration of the load into large blocks, as proposed in Sweden and Norway, requires additional distribution facilities if steam heating is used. More than 10,000 homes in a new suburb of Stockholm will be heated with steam from the R3/Adam reactor, on which work was begun in 1957. The reactor, Fig. 2, will be located in an underground chamber, a construction technique perfected in Sweden in connection with large hydroelectric power stations. R3/Adam is not a commercial installation and will have to be subsidised from the Swedish budget for nuclear research. It is likely that centralised domestic heating, particularly in more temperate climates, will become a success only when the cost of electric heating drops to such an extent that the added amenity may compensate for the extra cost. Such a situation can only arise in a rich society, and there are indications that electric heating is spreading in certain parts of Canada. The development, however, leaves the prospects of nuclear heating unaffected.

Kitchens for Thousand Homes

There is one particular field of domestic fuel consumption where a significant concentration of the fuel bill has occurred without the installation of additional distribution facilities. That field is food preparation. Over the past fifty years the trend has been increasingly towards factory prepared food, and processing plants now concentrate in large blocks the heating requirements of thousands of kitchens scattered over the countryside. Food preparation is one of the major industries in a well developed country. In countries just catching up with American buying habits, the growth of food processing—along with domestic appliances—may even outstrip other branches of manufacturing. The annual fuel requirements of selected process industries are compared in Fig. 1 with the fuel consumption of petroleum refineries taken as 100.

High Temperature Applications Eliminated

Leaving domestic heating aside, process industries in America consume some 350 million tons of coal annually, or about 1¾ times Britain's yearly coal production. A very large proportion of this potential market is eliminated by the characteristics of nuclear reactors: low-temperature heat, large unit size, and high first cost. Process heat can be broadly divided into two fields of application: high-temperature or furnace heat; and low-temperature or indirect heat. The fuel consumption in both temperature ranges is about equal, but nuclear reactors cannot be applied as a high-temperature furnace at the present. Although certain high-temperature reactors could conceivably operate at 2,000° C (3,600° F), which is adequate even for blast furnaces and glass making, direct heating would involve passing the process material through the reactor core. Problems of neutron economy and induced radiation would arise in addition to the problem of fission product containment in a reactor using unclad ceramic fuel through which process material is circulated. The temperature limitations of orthodox reactors eliminate industries such as ceramics, metal smelting and fabricating from potential customers.

Competition with Cheap Coal

Once the field is narrowed to steam-heating applications with temperatures ranging from 250 to 400° F, the criteria for successful installations can be established. High capital cost and, for the time being, high production costs, characterise heating reactors as well as power reactors. High load factor and locations where conventional fuels are abnormally expensive will be essential requisites for an economic installation, eliminating all industries located near coal or natural-gas fields, and most industries operating on a single shift, five-day-week basis. But among many continuously operating industries such as petrochemicals, pulp and paper, and some food canners, load factors considerably in excess of 0·7—the currently accepted figure for CEGB nuclear power stations—can be maintained. Only the need for maintenance keeps the load factor below 1·0, and 0·9 may be regarded as a reasonable value. In such industries the break-even point of nuclear power and fossil fuel can be reached in competition with cheaper coal than required for economic nuclear electricity generation. Alternatively, the smallest economic size of reactor is reduced at high load factors, bringing a number of smaller manufacturers within the range of nuclear heat.

Heat-Intensive Industries

The most intensive user of heat is the chlorine and alkali branch of the chemical industry, where 5·6 per cent of the product's cost is due to heating. The average size plant uses some 200 MW of heat, with larger plants as high as 300 MW. Beet sugar processing comes second, with a heat requirement equivalent to 4·14 per cent of cost, but sugar refineries tend to be small and operation is seasonal. Petroleum refining, although a heat-intensive industry, usually has quantities of hydrocarbon residue available at low cost for the generation of heat. Single plants tend to be very large, using 500 MW, but nuclear reactors could only become competitive under special conditions, or if better use than burning is found for refinery byproducts. Somewhat less than 3 per cent of the cost of paper pulp and finished paper is caused by the fuel bill. Large pulp mills use heat in the order of 100 MW—at a load factor better than 0·9. Output of paper mills is strongly dependent on the standard of living and may be expected to be among the first to react to improvement: nuclear heat is well placed to supply added requirements. As the globe is shorn of trees mills tend to move further from low cost fossil fuel areas. In addition to heat, the mills require considerable mechanical energy, which is usually produced locally in back-pressure turbines.

Sale or Persuasion

With regard to the "uncommitted industries of the world," there are two promising approaches whereby a heating reactor migh be sold without benefit of a prototype. If there is a strong indication —or confidence—that in competition with fossil fuel of a certain price the proposed nuclear reactor will show greater economy than a conventional boiler, then a direct sales approach can be made. To gain the greatest advantage, it is desirable to select the industries where heating cost makes the highest contribution to the cost of the finished product.

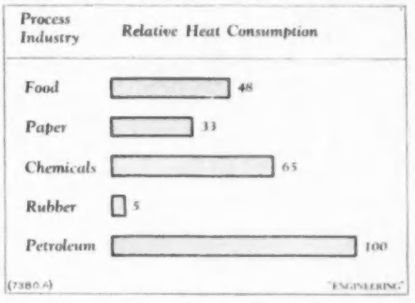


Fig. 1 (above) Comparative heat consumption of selected process industries.

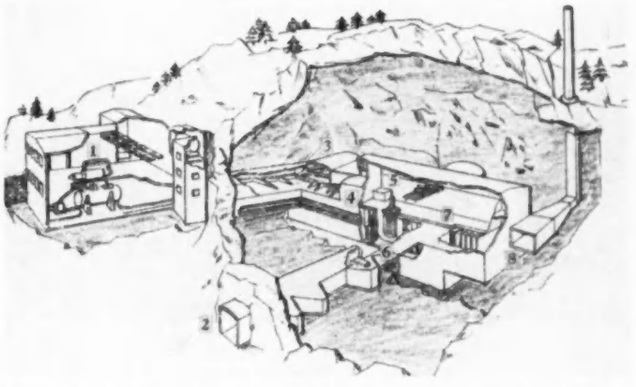
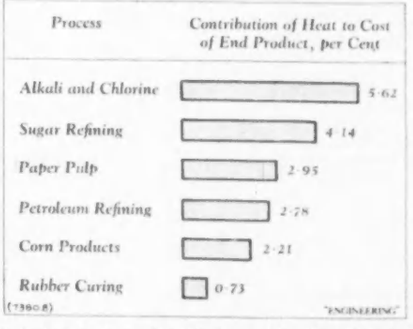


Fig. 2 (left) Sweden's R/3-Adam will provide domestic heating for 10,000 homes in Stockholm.

1. Turbine hall. 2. Entrance. 3. Control room. 4. Heat exchanger. 5. Charge machine. 6. Reactor. 7. Fuel storage. 8. Ventilation duct.

Fig. 3 (below) Cost of process heat as fraction of finished cost for selected products.



Such industries, selected from Fig. 3, might be alkalies and chlorine, corn products, and pulp and paper mills. If, on the other hand, there is less confidence in the reactor's performance and it is desired to gain experience in a commercial installation, a different kind of producer has to be approached. It will be easier to persuade someone with a product, the cost of which is almost independent of heating cost, to try an unproved installation. The important consideration is the total heat consumption and the load factor. Suitable industries might be rubber products, where heat accounts for less than 1 per cent of finished cost, or food with less than ½ per cent.

Possibility of Byproduct Radiation

As a further incentive to sales, in certain cases it is possible to tempt the customer with the possibility of byproduct irradiation. It is known that irradia-

tion can be applied with marginal economy in a number of chemical processes, sterilisation, food preserving, and rubber vulcanising (Atomic Review, 22 January, 1960). When both the heat and radiation output of the reactor are utilised, the economics of the reactor installation is greatly improved.

Notes and News

Sizewell Rated 650 MW, Oldbury may be 1,000 MW

Consent has been given to construct a 650 MW (e) station at Sizewell, Suffolk, and a 500 MW station at Dungeness, Kent. The rating of CEGB power stations has more than doubled since the first two tenders for Bradwell and Berkeley were accepted, but the end is still not in sight. If the Ministry of Power approves the Oldbury project, a 1,000 MW station will be built on the Gloucestershire site. It is probable that Oldbury will be the first departure from the current two-reactor layout adopted by the CEGB so that the individual rating of reactors may not be affected.

Five Tenders for Ship Reactor

The Ministry of Transport has asked five companies to submit tenders for a nuclear reactor suitable for ship propulsion. The tenders are restricted to boiling water and organic moderated reactors. The five companies are AEI-John Thompson, Babcock & Wilcox, English Electric, Hawker Siddeley and Mitchell-Fairfield.

Royal Navy's Nuclear Ships

Construction of surface ships with nuclear propulsion will be considered by the Board of Admiralty in about six months time when a report on nuclear machinery is submitted. During a recent trip to naval installations in Scotland, Mr. Orr-Ewing, Civil Lord of the Admiralty, stressed the importance of developing suitable machinery for naval propulsion in the United Kingdom. An announcement on the launching date for the nuclear submarine Dreadnought is expected within the next two months.

Small Reactor Prototypes : BWR and OMR

Proposals for power reactors in the 50 MW(e) range have been invited by the USAEC. Two systems, the boiling-water and organic-moderated reactors are under consideration. It is expected that advances in the engineering of the boiling-water reactor will result in a design combining the advantages of both the direct and indirect cycles. Aim of the organic-moderated prototype is to test the lifetime of improved fuels, possibly uranium oxide with sintered aluminium powder canning. The Commission will support research and development, and will waive fuel charges during the first five years of operation.

Proceedings of Thermonuclear Convention Published

In April, 1959, a convention was held in Britain on the development and engineering of thermonuclear devices and special problems related to constricted plasmas. (See Atomic Review, 1 May and 8 May, 1959). Papers were presented on the history of the British toroidal pinch machine Zeta, developments in the United States and in Russia, and the engineering of electrical apparatus required for the discharge of large electrical currents. In the last session of the Conference, the future of thermonuclear research, was discussed, in particular the fast pinch techniques, pinch stabilisation, and direct conversion of fusion energy. The papers and discussion have now been published as a supplement to the *Proceedings of the Institution of Electrical Engineers*, vol. 106, 1959. Price is £1 2*s* 0*d* to members of the Institution and the BNEC, and £2 0*s* 0*d* to non-members.

IAEA Research Contracts Around the World

Forty-seven research contracts have so far been awarded by the IAEA to promote wider application of radiation and radioactive substances, and to reduce the hazards of the peaceful application of nuclear energy. Total budget will be $400,000. Countries not normally represented in international research undertakings, such as Poland, Czechoslovakia and Iraq, are among the 20 participants.

High Activity at IAEA

The year opened with a flurry of activity at IAEA headquarters in Vienna. Good progress was made on the Agency's laboratories at Siebersdorf during 1959 and a consignment of instrumentation valued at $30,000 has been received as a gift from the French Government. Activities of the Agency were reviewed at the governors' first meeting in January. Major projects in 1959 included arrangements for the supply of enriched fuel for Finnish and Austrian reactors, coordination of a large international undertaking for the measurement of environmental radiation, and an evaluation of principles whereby the Agency could safeguard against the appropriation of IAEA reactor materials for military purposes. Nearly 200 students were studying on IAEA fellowships, and a further 400 have been selected for next year. Present staff of the Agency consists of 179 professional members and 244 general service employees.

Crossflow Heavy-Water Reactor Proposed in Sweden

Engineers of AB Atomenergi, in cooperation with the Swedish Power Board, have put forward a proposal for a novel reactor type described as a crossflow heavy-water reactor. The fuel elements would be arranged in horizontal layers instead of the more common vertical arrangement, while the heavy-water coolant and moderator flows across the fuel element banks in a vertical direction. It is claimed that the arrangement results in exceptionally good control response and improved heat transfer as well as the possibility of reducing capital costs.

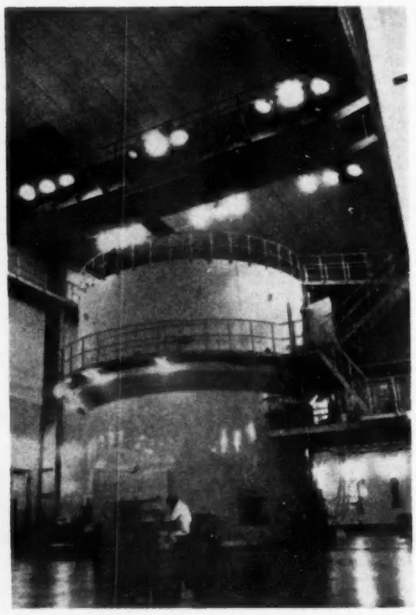


Fig. 4 The Boris Kidric Institute's research reactor is typical of a number supplied by Russia.

Work on the project is only in a preliminary stage and no construction plans have so far been made.

Nuclear Courses in Montreal, Saclay, Harwell

McGill University of Montreal offers a one year diploma course in nuclear engineering similar to that offered by Imperial College. Admission regulations are the same as for a master's degree.

Two short courses in the technical problems of nuclear energy are offered by OEEC for senior engineers and industrialists, one in French at Saclay near Paris; the other in English at Harwell. Both courses will be held in July. Further information may be obtained from OEEC, 38 Boulevard Suchet, Paris 16e.

Reactor Simulator for Operator Training

A 200 amplifier reactor analogue will be supplied to Calder Hall by Short Brothers and Harland. The reactor simulator will be used for the training of operators for CEGB and South of Scotland Electricity Board nuclear power stations.

Petten Reactor Containment Tested

Construction of the containment building for the Dutch material testing reactor HFR is complete. The building has passed a two-week testing schedule to determine gas-tightness and structural integrity.

Criticality Detection for Plutonium Plants

In addition to radioactivity and toxicity, plutonium processing plants must guard against accidental accumulation of a critical plutonium mass. Windscale's second plutonium plant will be equipped with a control system to detect and locate critical accumulations, and to give the alarm for the evacuation of affected areas. The detection system was developed by the UKAEA and will be manufactured by Avo Limited, London.

Western Site for Canadian Reactor Centre Named

AECL announced the new site for Chalk River's western branch in Manitoba. The move to decentralise Canada's nuclear industry was first reported in Atomic Review on 23 October, 1959. The site is 60 miles north of Winnipeg, on the Winnipeg River, and will be renamed Whiteshell from the present "Lac duBonnet."

Anglo-Spanish Exchange and Cooperation

Cooperation in the peaceful application of atomic energy is the subject of an agreement between Spain and the United Kingdom, signed in Madrid on 20 January. The agreement will facilitate sale of British reactors, fuel and nuclear equipment in Spain, and the training of Spanish scientists and engineers in the United Kingdom.

Yugoslav Reactor Officially Opened

President Tito inaugurated the Boris Kidric Institute's research reactor last December. Of the same pattern as a number installed in various Eastern countries, the reactor was supplied by the Soviet Union under an exchange agreement. A view of the reactor hall is shown in Fig. 4.

Decontamination of Water Reactors

Decontamination procedures are essential to the maintenance of water reactors. The build up of radioactivity on pressurised-water reactor components can be controlled by careful selection of materials. Use of low impurity materials such as type 347 stainless steel with reduced cobalt and tantalum content, and application of axial bed filters may reduce contamination. Activity on reactor surfaces is caused by deposition of nuclides activated in the high-flux region of the core. Fission-product contamination is normally small. Reactors using stainless steel components show cobalt-60 and 58, iron-59, manganese-54 and chromium-51 contamination. The recommended decontamination procedure is the fill-flush method using the following sequence: fill with caustic permanganate for 30 minutes at 225° F; flush with water; fill with citrate combination at 225° F; followed by 15-minute water-flushing cycles until the required purity is attained. The treatment results in a 98 per cent reduction of gamma activity. (Decontamination of Pressurised Water Reactors, J. L. Zegger, and G. P. Pancer, 1959 ANS Winter Meeting, paper 9-4.)

Flow Behaviour in Non-Newtonian Slurries

Many flow systems consisting of a liquid suspending medium and a solid suspension do not follow the linear Newtonian relationship of shear rate and shear stress. Behaviour of a non-Newtonian thoria slurry has been investigated for possible application in the circulating blanket of an aqueous homogeneous reactor. Crowley and Kitzes have suggested that the effective volume of solids in suspension is greater than the actual volume owing to a layer of static fluid adhering to the surface of the particles, and have proposed a formula to correlate shear rate and shear stress. Tests with thoria slurries of various concentrations confirm the usefulness of the Crowley-Kitzes equation, but the value of the dimensional constant C was found to vary with particle size and degree of flocculation. Friction factors were found to be dependent on pipe diameter in the laminar region, but independent in the turbulent region. The turbulent friction factor also increased with increasing particle size. Transition from laminar to turbulent flow could be predicted from the intersection of laminar and turbulent friction factor curves with reasonable accuracy, but it was found that inhomogeneity occurred at approximately 1½ to 3 times the predicted velocity. (Pumping Studies on Aqueous Thoria Slurries, by R. Murdoch and H. A. Kearsey, AERE report CE/R 2856.)

Adsorption in Clay

Heat transfer is likely to be one of the problems associated with the method of disposing high activity wastes baked into montmorrillonite clay and then placed into deep boreholes. It is important to set limits upon the diameter of the borehole to allow for adequate cooling of the clay, which would tend to fissure if heat generated by decay is not removed. Approximate calculations show that 1 micromole per gm clay concentration of short-half-life isotopes would induce a temperature rise of 160 to 180° C in a 5 cm bore hole, but the temperature rise would be in the order of 2,000° C if the bore hole were 20 cm. Maximum temperature would be reached in about a month. (Cooling of Underground Fission Wastes, by J. K. Perring, AERE C/R 1294.)

IMPERIAL SMELTING

U.K. MEMBER OF THE CONSOLIDATED ZINC CORPORATION LIMITED

The following engineering vacancies are currently available at the Avonmouth Works and in Group Departments on the Avonmouth Site:—

AVONMOUTH WORKS

Assistant Area Engineer

Duties involve controlling work done by tradesmen and labourers on zinc blast furnace and associated plant, including provision of spares, operation of bonus schemes, and general supervision of engineering maintenance work. An apprenticeship, preferably in heavy engineering, and professional qualification or degree in Mechanical Engineering essential. Previous experience in a supervisory capacity in heavy chemical or metallurgical industry is desirable. Age limits 23-35. Ref. EG/ENG/70.

CHIEF ENGINEER

Engineering Assistants

Opportunities to train for future engineering posts of responsibility exist for two young men with a university degree or Higher National Certificate in Mechanical or Chemical Engineering. Mobility is important since the persons appointed may be required to work for indefinite periods at any of the seven Works Sites. Ref. EG/ENG/71.

Group Mechanical Engineer

One of a team of design engineers who are collectively responsible for the detail design work arising out of capital expenditure projects at any of the Corporation's Works and for following the projects through to their completion, including procurement and construction. A university degree or professional qualifications in Mechanical Engineering will be required, together with sound design experience, preferably in heavy engineering. Ref. EG/ENG/72.

Draughtsmen

For the development of schemes and detailing of equipment to guide invitations to tender and the manufacture of plant. At least five years' experience, preferably in heavy engineering, is required and preference will be given to candidates holding N.C. or H.N.C. in Mechanical Engineering. Ref. EG/ENG/73.

IMPERIAL SMELTING PROCESSES LIMITED

Design Engineer

A qualified engineer, preferably with a first class honours degree and sound experience, including design in the heavier type of engineering, is sought. Duties are to participate in the design and development of blast furnaces and ancillary plant for the Imperial Smelting Process and in this instance fluency in both written and spoken German is very desirable. Ref. EG/ENG/74.

CZC

Applications, quoting the reference(s) of particular interest and giving brief details of qualifications and experience, should be addressed to:—

Personnel Manager,
IMPERIAL SMELTING CORPORATION LTD.
St. Andrew's Road, Avonmouth, Bristol.

B 154

TECHNICIANS

required by

THE ATOMIC WEAPONS RESEARCH ESTABLISHMENT, ALDERMASTON, BERKSHIRE.

To be responsible to an Engineer for interpreting his instructions for the development, manufacture and test of a wide variety of electronic equipment. These posts require a very high degree of individual skill.

Applicants should have served a recognised apprenticeship or have had equivalent training. Experience of electronic development work is essential and a wide knowledge of associated measuring techniques is very desirable. Candidates should have an O.N.C. or equivalent qualification.

SALARY:

£925 (at age 30 or over)—£1105.

Contributory Superannuation Scheme. A house, or substantial assistance with house purchase, will become available for married officers living beyond daily travelling distance.

POST CARDS for application forms to the **SENIOR RECRUITMENT OFFICER** at above address. Please quote ref. 2423/26. B 200

BRITISH RAILWAYS RESEARCH DEPARTMENT ENGINEERING DIVISION, DERBY

Vacancy for

SCIENTIFIC OFFICER Grade 2

Initially to study problems connected with dynamics of trains, shocks to goods in transit, etc. Candidates should have good degree. Previous experience of research not essential.

Salary range: £665 to £985 per annum (commencing salary according to qualifications and/or experience).

Superannuation and certain travel facilities.
Medical examination.

Applications, stating age, experience, etc., to:—

DIRECTOR OF RESEARCH (BRITISH RAILWAYS)
BRITISH TRANSPORT COMMISSION
222 MARYLEBONE ROAD
LONDON, N.W.1. B 209

'Engineering' Appointments Section

PUBLIC APPOINTMENTS

CITY OF OXFORD
EDUCATION COMMITTEE
COLLEGE OF TECHNOLOGY

Applications are invited for the following posts from Easter, 1960:

LECTURER IN ELECTRICAL ENGINEERING for O.N.C. and H.N.C. Courses, preferably with ability also to assist with work for Part III I.E.E. Good degree or corporate membership (by examination) of I.E.E. and industrial and some teaching experience required.

ASSISTANT GRADE "B" in Physics for G.C.E. "O" and "A" levels and as a main and ancillary subject for National Certificates. Graduate required.

Salaries in accordance with the Burnham Technical Report, 1959.

Further information can be obtained from the PRINCIPAL, COLLEGE OF TECHNOLOGY, HEADINGTON ROAD, OXFORD, to whom applications must be returned within 14 days of the appearance of this advertisement. B 223

CENTRAL ELECTRICITY GENERATING BOARD
EASTERN DIVISION

Applications are invited for the following appointments in the Generation Department (Construction Section) at Divisional Headquarters (Cockfosters in North London).

SENIOR DRAUGHTSMAN

Salary, N.J.B., Schedule D, Grade 4, £980 by £20 to £1080 inclusive of London Weighting.

The duties of the successful applicant will include work on the layouts for high voltage transmission lines and substations involving the preparation of overhead line profiles and substation and switchgear arrangements and associated civil engineering works.

Applicants should have technical qualifications, preferably to the standard of Higher National Certificate and should have had experience of this type of work.

SENIOR DRAUGHTSMAN

Salary, N.J.B., Schedule D, Grade 5, £830 by £20 to £940 inclusive of London Weighting.

The duties of the successful applicant will include work on the layouts for high voltage transmission lines and substations.

Applicants should have technical qualifications to the standard of Ordinary National Certificate and should have had experience of this type of work.

Applications, quoting reference 2/11336, stating age, qualifications, experience and present position should be sent to the CONTROLLER, CENTRAL ELECTRICITY GENERATING BOARD, EASTERN DIVISION, WEST FARM PLACE, CHALK LANE, COCKFOSTERS, BARNET, HERTS., to arrive not later than 13th February, 1960. B 222

BRADFORD INSTITUTE OF TECHNOLOGY

PRINCIPAL: E. G. EDWARDS, Ph.D., B.Sc., F.R.I.C.

Applications are invited for the posts of SENIOR LECTURER in Mechanical Engineering. LECTURER in Mechanical Engineering.

Candidates should be well-qualified and industrial and research experience would be a recommendation. The successful candidate will be required to teach one or more subjects to honours degree standard. They will be encouraged to undertake research and adequate facilities will be available.

Salary scales: Senior Lecturer, £1550-£1750 per annum.
Lecturer, £1370-£1550 per annum.

Previous industrial and research experience at a suitable level may be taken into account in fixing the commencing salary.

Further particulars and forms of application may be obtained from the REGISTRAR, BRADFORD INSTITUTE OF TECHNOLOGY, BRADFORD 7.

HENRY PATTEN,
CLERK TO THE GOVERNORS.
B 220

CIVIL ENGINEERS FOR DEPARTMENT OF MAIN ROADS, NEW SOUTH WALES, AUSTRALIA

Applications are invited from graduates (or undergraduates in their final year) in Civil Engineering of a recognised British or Irish University for appointment to the staff of the Department of Main Roads, New South Wales, the State Road Authority for construction of roads and bridges.

On appointment, applicants may be engaged at the Department's Head Office, Sydney, on the design of reinforced concrete and steel bridges, or on main road construction and maintenance either in the Metropolitan Area or the country.

Commencing salary according to qualifications and experience will be within the range £A1185 to £A1410 per annum, with annual progression, subject to technical competence to £A2095 per annum. Appointees will be eligible to contribute to the State Superannuation Fund after six months.

Appointee's full fare from England to Australia will be met by the Department, subject to a three years' service guarantee bond being completed. Appointment will be subject to passing a medical examination and preference will be given to applicants not more than 30 years of age.

Applications should be made on forms obtainable from the AGENT GENERAL FOR NEW SOUTH WALES, 56 STRAND, LONDON, W.C.2. B 238

AUSTRALIA
THE UNIVERSITY OF NEW SOUTH WALES
SENIOR LECTURER/LECTURER IN HIGHWAY ENGINEERING

The University invites applications for appointment to the positions of SENIOR LECTURER/LECTURER in its SCHOOL OF HIGHWAY ENGINEERING.

Salary: Senior Lecturer, £A2224 range £A2574 per annum.
Lecturer, £A1524 range £A2124 per annum.

Commencing salary according to qualifications and experience.

Applicants must possess a degree of high standing in engineering and should have had experience in general civil engineering. Previous research experience and corporate membership of the Institution of Engineers of Australia is desirable.

Knowledge of one or more of the following subjects will be an advantage:

Soil mechanics, town planning, land drainage, quarrying, structural engineering and bridge design, reinforced concrete and prestressed concrete, road location and design, road construction and maintenance, bituminous construction and design of bituminous mixes, specifications, quantities and contract documents.

Successful applicants will lecture at post-graduate levels and participate in research programmes.

Appointees will be eligible for 12 months' study leave on full salary after 6 years of service.

Subject to passing a medical examination the appointees will be eligible to contribute to the State Superannuation Fund.

First-class ship fares to Sydney of appointees and families will be paid.

Four copies of applications should be lodged with the AGENT-GENERAL for NEW SOUTH WALES, 56-57 STRAND, LONDON, W.C.2, and a copy forwarded by airmail in an envelope marked "University Appointment," to the BURSAR, THE UNIVERSITY OF NEW SOUTH WALES, BOX 1, POST OFFICE, KENSINGTON, NEW SOUTH WALES, AUSTRALIA, by 19th MARCH, 1960. B 237

Junior Plant Engineers
Metallurgists
Chemists and Physicists

THE UNITED KINGDOM ATOMIC ENERGY AUTHORITY
PRODUCTION GROUP REQUIRE
JUNIOR PLANT ENGINEERS, METALLURGISTS, CHEMISTS AND PHYSICISTS AT

CAPENHURST WORKS, CHESTER
CHAPELCROSS WORKS, ANNAN, DUMFRIESSHIRE
SPRINGFIELDS WORKS, SALWICK, PRESTON, LANCS., AND
WINDSCALE & CALDER WORKS, SEASCALE, CUMBERLAND

The Group is responsible for the operation of reactor stations at Calder and Chapelcross, the prototype Advanced Gas Cooled Reactor and chemical processing plants at Windscale, the fuel element production plants at Springfields and the gaseous diffusion plant at Capenhurst. The Works processes are controlled by Engineers and Scientists with a background of industrial experience. The work includes production control, labour management, critical examination of costs in relation to chemical and physical plant operation. In each Works there is a large Engineering Branch responsible for plant and instrument maintenance and workshop organisation.

These appointments are in an introductory grade with duties designed to give varied experience in aspects of works operation with a view to promotion to managerial status and possible advancement to more senior staff.

Engineers are required to have an honours degree in engineering, with approved apprenticeship or experience, a diploma of technology, or graduate membership of a senior engineering institution. Consideration will be given to candidates who are nearing completion of qualifications for graduateship.

Chemists and Physicists must have an honours degree in Chemistry, Physics, Metallurgy, Engineering or Chemical Engineering, or equivalent.

Commencing salary according to age within scale — £595 (at age 20) to £1,025
Contributory Superannuation. Staff Housing Scheme.

Send postcard to the Works Secretary at the location of your first preference quoting reference P.126/72

B 213

AIR MINISTRY

AIR MINISTRY Works Designs Branch requires in LONDON—STRUCTURAL ENGINEERING DESIGNER DRAUGHTSMEN for reinforced concrete or structural steelwork of all types. Applicants must have adequate training and several years' experience. Some site experience and possession of recognised technical qualification an advantage. Financial assistance and time off may be allowed for recognised courses of study. Promotion and pension prospects. Five-day week with 18 working days leave per year initially.

Salary for Grade III ranges from £680 (at age 25) to £900 p.a. Commencing salary dependent on age, qualifications and experience. Also vacancies in higher grade for suitably qualified candidates on range from £895 to £1055 p.a. Applicants, who must be natural born British subjects, should write to AIR MINISTRY, W.C.1., LACON HOUSE, THEOBALDS ROAD, LONDON, W.C.1, or to any Employment Exchange (quoting Order No. Kings Cross 3745) giving age, details of training, qualifications, full particulars of former posts held and copies of any testimonials. Candidates selected will normally be interviewed in London and certain expenses reimbursed. G 842

THE POLYTECHNIC
309 REGENT STREET, LONDON, W.1

DEPARTMENT OF CIVIL AND MECHANICAL ENGINEERING

Applications are invited for the following full time posts:

(1) LECTURER in Civil Engineering, to teach a range of Civil Engineering subjects to final Degree and Diploma students.
(2) LECTURER in Metallurgy, to teach final Degree and Diploma Students and to develop the metallurgy laboratories.

The appointments will commence on 1st September 1960. The salary scale commences at £1370 and rises by annual increments of £35 to a maximum of £1550 per annum plus London allowance of £38 or £54.

Further particulars and a form of application (which should be returned not later than February 29th) may be obtained from the undersigned.

J. E. RICHARDSON,
DIRECTOR OF EDUCATION. B 215

UNIVERSITY OF LONDON
KING'S COLLEGE

LECTURER
IN MECHANICAL ENGINEERING

Applications are invited for this post. Candidates should have a good Honours degree and some experience of teaching and/or research in Engineering Science. Industrial or other professional experience is also desirable.

The salary will be on the scale £900 by £50 p.a. to £1350 by £75 p.a. to £1650, with starting point according to qualifications and experience. A London allowance of £60, family allowances, and F.S.S.U. benefits will also be payable.

The formal conditions of appointment and application forms may be obtained from the **REGISTRAR, KING'S COLLEGE LONDON, STRAND, W.C.2.** Completed forms must reach him by February 29th. B 211

BRITISH RAILWAYS RESEARCH DEPARTMENT
ENGINEERING DIVISION, DERBY

A SCIENTIFIC OFFICER GRADE 2 is required for interesting work on the design of electronic measuring equipment, involving an increasing use of semi-conductors. Ample opportunities for following up the use of the equipment in field trials.

Candidates should have a good science degree and a grasp of electrical first principles. Previous research experience not essential.

Salary range, £665 to £985 per annum (commencing salary according to qualifications and/or experience).

Superannuation and certain free travel facilities.

Medical examination.

Applications, stating age, experience, etc., to:—

DIRECTOR OF RESEARCH (BRITISH RAILWAYS),
BRITISH TRANSPORT COMMISSION,
222 MARYLEBONE ROAD,
LONDON, N.W.1. B 210

INDUSTRIAL LIAISON OFFICER

The Coil Spring Federation Research Organisation requires an Industrial Liaison Officer to strengthen technical relations between the research laboratories and member firms. He will be required to visit member and non-member firms with a view to stimulating their interest and increasing the membership of the Organisation; he will be based in Central England, the actual location to be fixed by mutual arrangement.

The successful applicant will be required to deal with people of the highest levels of industry so that the right personality is a most important quality. A knowledge of the heat treatment or cold work of high tensile materials is desirable.

A commencing salary up to £1500 per annum will be paid according to age and experience. Pension scheme. Applications giving age, education, qualifications and experience to Director of Research, Coil Spring Federation Research Organisation, Doncaster Street, Sheffield, 3. B 256

FOURAH BAY COLLEGE
THE UNIVERSITY COLLEGE
OF SIERRA LEONE

Applications are invited for (A) SENIOR LECTURER to be Head of Department of Engineering and (B) LECTURER in Engineering. Salary scales: (A) £1700 by £75 to £2150 p.a., plus Head of Department allowance £150 p.a. (B) £965 by £50 to £1415; £1490 by £75 to £1790 p.a., entry point according to qualifications and experience. F.S.S.U. Outfit and family allowances (maximum £300). Passages on appointment, annual leave and normal termination. Part-furnished accommodation at reasonable rent.

Detailed applications (6 copies), naming 3 referees, by 15 March, 1960, to SECRETARY, INTER-UNIVERSITY COUNCIL FOR HIGHER EDUCATION OVERSEAS, 29 WOBURN SQUARE, LONDON, W.C.1, from whom further particulars may be obtained. B 240

INSTRUMENT ENGINEERS

Candidates must have University Degree with 4 years' experience in Instrument Engineering, or H.N.C. with 6 years' experience. Experience should preferably be in refinery process instrumentations. Operating experience would be an advantage. Duties of the successful applicants will cover the selection of instruments, the determination of their location, and applications in the process; preparation of process control diagrams, instrument specifications and data sheets; writing of requisitions and review of vendors' quotations; instrument calculations, locating the physical position of instruments and the preparation of instrument board layouts.

Above average salaries, comprehensive personnel benefits include contributory pension scheme, excellent working conditions, luncheon vouchers, Social Club, etc.

Please write to the Personnel Manager:

KELLOGG INTERNATIONAL CORPORATION

7-10, CHANDOS STREET, CAVENDISH SQUARE LONDON, W.1. *TEL: MUSEUM 4010*

quoting reference 155/H

B 202

CHIEF PROCESS ENGINEER

Minimum B.Sc. Chemical Engineering, A.M.I.Chem.E., with considerable post-degree industrial experience, including minimum four years in chemical process design engineering. Must have held responsible position in a process design department, be completely familiar with mass and heat transfer equipment and be able to evaluate equipment design. Responsibilities will include the direction and control of the Company's process design of complete low temperature plants from sales inquiry stage to commissioning.

Apply: Personnel Manager,
AIR PRODUCTS (GB) LTD.,
49/50, POLAND STREET,
LONDON, W.1.
B 258

MANCHESTER REGIONAL HOSPITAL BOARD

ARCHITECTURAL, ENGINEERING AND SURVEYING STAFF

A substantial expansion of the hospital capital building programme offers valuable opportunities to ambitious Architects, Engineers, and Surveyors. Vacancies are available in the following grades. The salary scales quoted are at present under review.

(*a*) PRINCIPAL ASSISTANT GRADE SCALE II—£1195-£1420 a year;
Architects.
(*b*) SENIOR ASSISTANT GRADE—£1050-£1245 a year;
Architects
Quantity Surveyors
Engineers (Mechanical, Heating and Ventilating)
Engineers (Electrical).
(*c*) ASSISTANT GRADE—£730-£1055 a year;
Architects
Surveyors (Land and Quantity)
Engineers (Mechanical, Heating and Ventilating)
Engineers (Electrical).
(*d*) SUB-PROFESSIONAL GRADE—£545-£765 a year;
Architects
Surveyors (Land and Quantity)
(*e*) DRAUGHTSMEN—£445-£660 a year.

Candidates for posts under (*a*), (*b*) and (*c*) must possess full professional qualifications and for posts under (*d*), intermediate qualifications. Draughtsmen must have had at least 3 years' previous experience. All posts are subject to National Health Service conditions and are superannuable.—Application forms, to be returned by 29th February, 1960, are obtainable from the SECRETARY OF THE BOARD, CHEETWOOD ROAD, MANCHESTER, 8.

B 225

THE UNIVERSITY OF LIVERPOOL

Applications are invited for TWO POSTS OF LECTURER in the Department of Building Science. The initial salary will be within the range £900-£1350 per annum, according to age, qualifications and experience.

Applications, stating age, academic qualifications and experience, together with the names of three referees, and quoting ref. CV/En, should be received not later than 5th March, 1960, by the REGISTRAR, from whom further particulars of the conditions of appointment may be obtained. B 201

INSTRUCTOR BRANCH, ROYAL NAVY

Applications are now invited for **SHORT SERVICE COMMISSIONS** in the Instructor Branch of the Royal Navy. The primary requirement is for men of good personal qualities with degrees (or the equivalent) in Mathematics, Physics or Engineering, but graduates in Chemistry, Metallurgy, History, Geography or English, will also be considered. An additional requirement exists for non-graduates with teaching qualifications.

Service in the Instructor Branch combines all the advantages of life in the Royal Navy—*e.g.*, comradeship, travel, a wide variety of cultural and sporting activities, a high standard of living, responsibility, etc.—with the opportunity to utilise scientific, technological and professional qualifications at all levels.

The work of the Instructor Officer is fundamental to the Fleet and covers the widest field of operational, technical and academic duties ashore and afloat, ranging from basic instruction to work on the latest developments in nuclear power and guided weapons. Instructor Officers are also the meteorologists of the Royal Navy.

Note also:—

*Students in their final year may apply.

*Short Service Commissions are granted initially for 3, 4 or 5 years and may be extended up to 12 years.

*£405 tax free gratuity, after a Short Service Commission of 3 years, and *pro rata* for longer.

*Starting pay is £511 p.a., rising to £620 p.a. after 1 year's service (£620 p.a. rising to £839 p.a. for 1st and 2nd Class Honours Graduates). This is augmented where appropriate by generous allowances, so that at the age of 30, a married Honours graduate could earn about £1750 p.a.

*Service in the Instructor Branch qualifies for Burnham Scale increments, and may be recognised for the purposes of the Teachers' Superannuation Acts.

*Short Service Officers may apply for Permanent Commissions.

*Candidates must be British subjects, sons of British subjects, under 36 years old, and medically fit.

For further details apply to:—
DIRECTOR, NAVAL EDUCATION SERVICE (P/14),
ADMIRALTY,
LONDON, S.W.1. B 257

NEWCASTLE UPON TYNE
STRUCTURAL ENGINEER

Applications are invited for the following superannuable appointment on the staff of the City Engineer.

Structural Engineer A.P.T. IV—£1065-£1220.

Applicants should have experience in reinforced concrete design and be corporate members of the Institution of Structural Engineers or the Institution of Civil Engineers.

Applications to the CITY ENGINEER, TOWN HALL, NEWCASTLE UPON TYNE; closing date, 29th February, 1960.

JOHN ATKINSON,
TOWN CLERK. B 255

UNIVERSITY OF SOUTHAMPTON

Department of Civil Engineering. Applications are invited for the post of LECTURER OR ASSISTANT LECTURER in Civil Engineering. Candidates should have some experience in the field of engineering research. Salary Scales: Lecturer, £900 by £50 to £1350 by £75 to £1650, with an efficiency bar at £1300. Assistant Lecturer £700 by £50 to £850. The initial salary will depend on qualifications and experience.—Further particulars should be obtained from the SECRETARY AND REGISTRAR, to whom applications (7 copies from United Kingdom applicants) should be sent not later than 1 March, 1960. B 251

WORKSHOP TECHNICIAN

WORKSHOP TECHNICIAN to assist in maintaining and repairing motor vehicle laboratory and workshop equipment. Motor vehicle engineering and workshop practice experience essential. Salary scale, £315 a year at 18 to £580. For holders of special qualifications £420 at 18 to £660.—Further particulars and application forms from SECRETARY AT L.C.C. PADDINGTON TECHNICAL COLLEGE, SALTRAM CRESCENT, W.9. (67.) B 249

APPOINTMENTS OPEN

ASSISTANT RESIDENT ENGINEERS

Water Tube Boiler Contractor requires ASSISTANT RESIDENT ENGINEERS for site construction. Previous shop and site experience is essential and technical qualifications to H.N.C. would be an advantage. Preferably age group 28-40. Salary would depend on experience and qualifications but would not be less than £800 p.a. plus subsistence allowance when working on site. Pension Scheme.—Full particulars of age, qualifications and career, quoting reference WT7, should be sent to BOX B176, Offices of ENGINEERING.

ENGINEER SURVEYORS

INSURANCE COMPANY has vacancies in various parts of U.K. for Engineer Surveyors for inspection of Boiler and Pressure Plant. Applicants not over 38 years must have 1st Class M.O.T. Certificate with Steam Endorsement or equivalent qualifications. Salary according to E.S.A. scale starting at £800 p.a. Non-contributory pension and other benefits.—Write BOX EG 886, LPE, ROMANO HOUSE, 399/401, STRAND, LONDON, W.C.2. B 218

SENIOR DRAUGHTSMAN

MAY & BAKER LTD., DAGENHAM, ESSEX, require a SENIOR DRAUGHTSMAN with experience in the design and layout of chemical or similar plant installations. Applicants should have technical qualifications to Ordinary National Certificate level or higher. Salaries are reviewed annually. There is a Pension Fund and Life Assurance Scheme in operation. Excellent canteen and sports facilities.—Apply initially in writing to the PERSONNEL OFFICER, quoting Reference No. 19/60. B 217

DRAUGHTSMAN, MECHANICAL (SENIOR)

DRAUGHTSMAN, MECHANICAL (SENIOR) required by the British Drug Houses Ltd. for layout and special machine development in their chemical laboratories. H.N.C. or equivalent preferred. Five-day week, Canteen, Sports Club, Pension and Profit Sharing Schemes—Apply in writing, stating age and educational attainments, to the STAFF MANAGER, GRAHAM STREET, CITY ROAD, N.1. B 241

DESIGN AND DEVELOPMENT ENGINEER

DESIGN AND DEVELOPMENT ENGINEER required by small but progressive Light Engineering Company in Sussex manufacturing own precision products. Must have a sound knowledge of thermodynamics.—Apply giving full particulars of experience, age, and present salary, to BOX B 236, Offices of ENGINEERING.

EXPERIENCED MECHANICAL DRAUGHTSMEN AND MECHANICAL DRAUGHTSMEN

PILKINGTON BROTHERS LIMITED have a number of vacancies for experienced mechanical draughtsmen designers and mechanical draughtsmen. The work would include design work of light, medium and heavy machines, under the direction of the Chief Designer in the Central Engineering and Planning Department.

Minimum qualifications—H.N.C. Good drawing office experience.

Assistance with house purchase, recreational and canteen facilities, five-day week, superannuation scheme.

Applications should be addressed to GROUP STAFF DEPARTMENT, PILKINGTON BROTHERS LIMITED, GROVE STREET, ST. HELENS, LANCASHIRE.

B 243

JUNIOR MECHANICAL ENGINEER OR DRAUGHTSMAN

With experience in chemical or similar engineering, required now by Arthur Guinness, Son & Co. (Dublin) Limited, St. James's Gate, Dublin. Age limit 26; must have H.N.C. or equivalent in engineering, good practical apprenticeship, and at least one year's drawing office experience on process plant and general engineering.

Starting salary in range £640 to £970 p.a., according to age and qualifications with annual advances. Substantial amenities and excellent prospects for progressive man.

Reply to CHIEF ENGINEER with particulars of age, education, training, and experience, in that order.

Expenses paid if selected for interview. B 194

RICHARD SUTCLIFFE LIMITED
MECHANICAL HANDLING SPECIALISTS REQUIRE
PROJECT ENGINEERS

Applications are invited from men who are approximately 30 to 40 years of age who have passed Higher National Certificate in Mechanical Engineering and preferably with some experience in structural work.

The persons appointed will be responsible for the preparation of schemes and quotations, for dealing with all contract formalities and for customer liaison.

The position calls for competent engineers with drive and initiative, capable of taking responsibility and of co-operating with other people in seeing a contract through, from start to finish.

Good salaries will be paid to the persons with the necessary qualifications and experience. The posts are pensionable.

Applications giving full details of past experience should be addressed to the PERSONNEL MANAGER, UNIVERSAL WORKS, HORBURY, NEAR WAKEFIELD. B 221

CENTRAL ELECTRICITY GENERATING BOARD

DESIGN AND CONSTRUCTION DEPARTMENT

Headquarters, London, S.E.1.

POWER PLANT DESIGN BRANCH

ASSISTANT ENGINEER required in the **Boiler Plant Section** to join a team engaged in the development of boiler design and in the checking and analysis of boiler tenders. Duties will include keeping the Board's boiler specification under continuous review in collaboration with other sections of the department.

Candidates should have a degree in Engineering and/or Membership of an appropriate professional Institution, and preferably should have experience in a boiler manufacturers' design department. The ability to write reports would be an advantage.

Salary within the scale £1,245 — £1,605 p.a.

Applications, stating age, qualifications, experience, present position and salary, to the Personnel Officer, 24/30, Holborn, London, E.C.1, by 15th February. Envelopes should be marked "Confidential Ref. ENG/25."

B 235

a number of DESIGN ENGINEERS

are required, with experience in the design and the associated calculations of Condensing, Feed Heating and De-aerating Plants for Land Service Power Stations.

Applicants should have a University Degree or equivalent qualification, with specialised experience in Heat Transfer.

Salaries offered will be appropriate to experience and responsibility, and there is a contributory Pension and Life Assurance Scheme in operation.

Barrow in Furness is pleasantly situated on the coast adjacent to the Lake District. The Company has a well-appointed Sports Club and Grounds, with comprehensive recreational facilities both social and sporting. An illustrated guide to the town and surroundings can be sent on request.

All applications should be addressed to the

ENGINEERING TECHNICAL MANAGER,

VICKERS-ARMSTRONGS (ENGINEERS) LIMITED,

Naval Construction Works, Barrow in Furness, Lancashire. B 134

CADBURY BROTHERS LIMITED

have a vacancy for a

MACHINE DESIGNER

With experience in the design of special purpose machinery. Applicants should preferably have gained the Higher National Certificate in Engineering or have similar qualification. Some experience in the Food Industry would be an advantage. Housing accommodation available.—Applications, stating age, experience, qualifications and salary, should be addressed to **CHIEF ENGINEER, CADBURY BROTHERS LTD., BOURNVILLE BIRMINGHAM.** B 205

T. I. (GROUP SERVICES) LIMITED

(THE SERVICE COMPANY OF THE TUBE INVESTMENTS GROUP)

A number of vacancies are available in the Plant Development Department of the above company for experienced

DESIGN ENGINEERS.

The work of the department includes a wide range of plant design, development of prototype machines, factory planning, progressing installation programmes, etc.

Excellent opportunities exist for promotion.

Applications are invited from men of 28-35 years of age with experience in the design of special-purpose machines and having as a minimum qualification Higher National Certificate or the equivalent. They should be sent, giving full details of qualifications, experience, present salary, etc., to the **PERSONNEL MANAGER, T.I. (GROUP SERVICES) LTD., ROCKY LANE, ASTON, BIRMINGHAM 6.** B 206

ВНИМАНИЮ ИНЖЕНЕРОВ ЭЛЕКТРОНИКОВ И ИНЖЕНЕРОВ МЕХАНИКОВ

ELECTRONICS

and

MECHANICAL ENGINEERS

looking for a new form of self-expression are invited to join an expanding organisation engaged on preparation of technical specifications for industry based a few miles North of London. Electronics experience desirable in one or more of the following fields: Radar systems, Microwave circuits, G.W. systems, Pulse circuits, Computers, together with H.N.C. or equivalent. Initial salary ranges from £900/£1150 per annum according to experience and qualification, plus cost of living allowance. The positions are permanent and offer unlimited scope for advancement. No knowledge of Russian necessary. Application form and detail of employment from A. D. Lacy, Technivision Limited, Braywick House, near Maidenhead, Berkshire. Maidenhead 5163. B246

THE MANCHESTER SHIP CANAL COMPANY

The Manchester Ship Canal Company invite applications for the appointment of ASSISTANT CIVIL ENGINEERS AND DESIGN ENGINEERS on the established staff of the Chief Engineer. Scale of salaries: £805 at age 25, rising by annual increments to £1250 at 38 with prospects of promotion to higher grades at salaries up to £1720.

Candidates should be Corporate Members of the Institution of Civil Engineers or hold equivalent qualifications, and should have experience in design, specifications, construction and maintenance of Civil Engineering works. Harbour and dock experience is preferable but not essential.

Successful applicants will require to become members of the Company's Contributory Superannuation Scheme.

Applications, stating age, qualifications and experience, should be addressed to the Chief Engineer, THE MANCHESTER SHIP CANAL COMPANY, SHIP CANAL HOUSE, KING STREET, MANCHESTER, 2, not later than 13th February, 1960. B 90

ANOTHER OPPORTUNITY IN IRON AND STEEL

BISRA

ENGINEERS AND PHYSICISTS

are required by the Plant Engineering and Energy Division for research on Steelworks Plant.

The positions to be filled provide interesting and varied work, and call for a capacity for original thought coupled with enthusiasm and drive to encourage the application of research results in iron and steel works.

Candidates should be graduates or corporate members of an appropriate Institution. Experience in the steel industry is not essential, but some experience in a heavy engineering industry is an additional advantage.

The Division's headquarters are at the London Laboratories in Battersea, but the research staff make frequent visits to works and the Association's other laboratories.

Applications are invited for the following positions:—

(1) **AN ELECTRICAL ENGINEER** to lead a team working on problems of automatic control of heavy electrically or hydraulically driven plant. The applicant should have a good knowledge of servomechanism theory and some experience of using harmonic response equipment or analogue simulators. Experience with heavy electrical plant is preferred. Starting salary in the range £1075 to £1425 or higher for a particularly suitable candidate. (Quote reference "E.E.2.")

(2) **AN ELECTRICAL ENGINEER** for work on automatic control of heavy plant. An interest in servomechanisms and some experience in this field is essential. Starting salary up to £1000. (Quote reference "E.E.3.")

(3) **TWO RESEARCH WORKERS** for the investigation of problems connected with the use of energy in steelworks processes. Qualifications in mechanical or chemical engineering would be suitable, or qualifications in physics or electrical engineering with an interest in heating probiems. Experience in any of the following would be an advantage:—fluidised beds, induction heating, temperature measurement, heat transfer mechanisms, combustion processes, or thermal properties of materials. Starting salary up to £1050, but one post might qualify for a higher salary for a particularly suitable candidate. (Quote reference "E.N.4.")

(4) **A CIVIL OR MECHANICAL ENGINEER** with experience in stress measurement or steel structures, to work on the recording of stresses in cranes and steelworks buildings with a view to improved design methods. Starting salary up to £1050. (Quote reference "E.17.")

Applications should be made in writing, quoting the appropriate reference number, to the Personnel Officer, The British Iron and Steel Research Association, 11, Park Lane, London, W.1. B 203

LAING

MECHANICAL DESIGN ENGINEERS

The following vacancies exist in the Laing Group of Companies. The work is of an interesting nature and concerned with the development of new machines and processes connected with the Building and Civil Engineering Industries.

SENIOR DESIGNER

required with experience in factory layout and factory machinery, for THERMALITE YTONG LIMITED. The work will involve the development of equipment for the production of high class building components. A.M.I.Mech.E. qualifications with experience in Mechanical Handling required.

SENIOR DESIGNERS

for the Research and Development Centre of John Laing and Son Limited at Boreham Wood. Applicants should be of A.M.I. Mech.E. standard and have experience in the development of new and improved types of CONTRACTORS' PLANT.

ASSISTANTS

to the above are required of H.N.C. or graduate level, some experience required.

GRADUATE MECHANICAL & CIVIL ENGINEERS

with Site experience in the operation of contractors Plant, for work involving the study, performance and development of the mechanisation techniques applied within the Contracting Industries.

All these posts are permanent and progresive. Pension Scheme.

Applicants should write in the first instance to:

Personnel Manager (Ref. M.D.E.3)
John Laing and Son (Holdings) Limited,
Page Street, N.W.7.

B 234

CLERK OF THE WORKS

A major Engineering Company of international repute and in the lead in its product fields wishes to appoint a Clerk of the Works at its largest establishment bordering on the Home Counties. The candidate, who should be well qualified in this field, must have both Civil and General Engineering experience as his duties will include the follow up of all work carried out by the Works Engineering Department, ensuring that correct estimates are given and that work is completed on schedule. Salary will be commensurate with experience and the post offers considerable opportunity for promotion.

Applications with full curriculum vitae including details of salaries earned may be made in strict confidence to BOX NUMBER 3164, c/o CHARLES BARKER & SONS, LTD., GATEWAY HOUSE, 1 WATLING STREET, LONDON, E.C.4. B 239

RESEARCH AND DEVELOPMENT ENGINEER

required
for work on the
COMBUSTION OF LIQUID FUELS

This position offers the successful candidate outstanding opportunities to carry out work, from fundamental research to commercial development, in the field of oil burning, in the newly formed Research Department of one of the pioneer companies of this Industry.

Applicants should have a degree in Mechanical Engineering or equivalent qualifications. Experience either in combustion or aerodynamics is desirable but consideration will be given to candidates without this experience who are otherwise suitable.

The Company operates a contributory superannuation fund and a life assurance scheme.

Applications which will be treated in strict confidence, should include details of age, education, experience and salary required, and be addressed to BOX B 107, Offices of ENGINEERING.

DETAIL DRAUGHTSMEN

EXPERIENCED DETAIL DRAUGHTSMEN required in Northern Ireland for development work on a.c. motors, 1-500 h.p. Draughtsmen also required for detail and, if possible, design of a.c. control gear for similar h.p. ratings. Good salary and pension scheme.—Reply giving full particulars of age, qualifications and experience to BOX B 182, Offices of ENGINEERING.

LEADING MIDLAND MACHINE TOOL COMPANY

have a vacancy for a

SALESMAN

to specialise in the sale of high grade Heavy Machine Tools. Good engineering training essential. Knowledge of steel industry an asset. Responsibilities include travelling the whole of the country and occasionally abroad. A car will be provided and there is an attractive pension scheme. Good basic salary and commission.—Applications giving full details of past experience together with age and salary expected, to BOX B 232, Offices of ENGINEERING.

JUNIOR CIVIL ENGINEER

JUNIOR CIVIL ENGINEERS required to work on sites with excellent opportunities for training. Applicants should be graduates or equivalent and should be between the ages of 20 and 26.

Apply in writing giving brief details of qualifications and experience (including vacation course work), also stating age, to: THE CHIEF ENGINEER, THE DEMOLITION & CONSTRUCTION CO., LTD., 3, ST. JAMES'S SQUARE, S.W.1. B 151

QUALIFIED ELECTRICAL ENGINEER

A vacancy exists for a qualified electrical engineer with an Hydro-Electric Power undertaking in Northern Nigeria. Pleasant climate 4,000 ft. above sea level. Age 30 to 35. Salary grade £1335/1565 according to age, qualification and experience. Pension and Life Assurance Scheme. Eighteen months tours with three months' leave on full salary. Free furnished quarters. Free passages self, wife and two children, or equivalent benefits if children remain at home.—Write BOX D401, c/o STREET'S, 110, OLD BROAD STREET, E.C.2. B 86

TRAIN FOR A CAREER IN TEACHING

ENGINEERING SUBJECTS

Persons aged between about 25 and about 45, with good industrial experience, are invited to apply for training as FULL-TIME TEACHERS OF ENGINEERING SUBJECTS IN TECHNICAL COLLEGES AND SCHOOLS.

EXCELLENT CAREER PROSPECTS

NEXT COURSE: SEPTEMBER, 1960, TO JUNE, 1961.

Applicants should hold suitable qualifications, *e.g.*, a university degree, associate or graduate membership of a professional institution, Higher National Certificate, Final or Full Technological Certificate of the City and Guilds of London Institute.

NO TUITION FEES:
PERSONAL, MAINTENANCE, DEPENDANTS' AND TRAVELLING GRANTS PAYABLE

For details write immediately, quoting S/21, to either

THE DIRECTOR, BOLTON TRAINING COLLEGE, MANCHESTER ROAD, BOLTON.
THE DIRECTOR, HUDDERSFIELD TRAINING COLLEGE, HOLLY BANK ROAD, HUDDERSFIELD.
THE PRINCIPAL, GARNETT COLLEGE, 83 NEW KENT ROAD, LONDON, S.E.1. B 204

DESIGN ENGINEER

required with experience of Charging and Defuelling Equipment, Fuel Element handling and shielding, in connection with Nuclear Projects.

Applicants with an Engineering Degree will be preferred and full particulars, stating age, qualifications and past experience should be sent to:

N.P.E.,
VICKERS-ARMSTRONGS (ENGINEERS) LTD.,
Naval Construction Works,
Barrow-in-Furness, Lancs

B 250

CIVIL ENGINEERING ASSISTANT

CIVIL ENGINEERING ASSISTANTS equired for site work on contracts. The work is varied and interesting with opportunities for promotion and study of new methods. Applicants should be between the ages of 26 and 32, and hold a degree in civil engineering or equivalent. They should have had a minimum of 3 years with a contractor on site work which must have included setting out and progress measurement. Experience in design of formwork and other temporary works, control of concrete quality would be an advantage.

Apply in writing, giving brief details of qualifications and experience, also stating age and salary required, to: THE CHIEF ENGINEER, THE DEMOLITION & CONSTRUCTION CO., LTD., 3, ST. JAMES'S SQUARE, S.W.1. B 150

ELECTRICAL DRAUGHTSMAN (SENIOR)

ELECTRICAL DRAUGHTSMAN (SENIOR) required by KODAK LIMITED with experience in the field of general distribution and utilisation. Qualifications and experience should be to H.N.C. standard or equivalent. Commencing salary approx. £850 p.a. The Company has approx. 5,500 employees at its Harrow factory and operates non-contributory sickness and pension schemes and a part contributory life insurance plan.—Please write for application form to MEN'S PERSONNEL DEPT., KODAK LIMITED (FACTORIES), WEALDSTONE, HARROW, MIDDLESEX. B 227

STEEL WORKS PLANT DESIGNERS

Openings offering good prospects are available for designers of proved ability with experience in Heavy Steel Works Plant, Heavy Shears, Handling Equipment and Ancillary Gear.

Applicants should be able to work out general designs to meet specifications, discuss requirements with customers and supervise preparation of detailed assemblies and drawings for manufacture.

In the first instance please give full details of age, training and experience.

Write BOX B 226, Offices of ENGINEERING.

TECHNICAL WRITER

TECHNICAL WRITER, over 25, required by a Company in West London for preparing instruction books and technical literature on a wide range of chemical treatment plant. Previous experience of technical writing is desirable but candidates who can prove they can write good English and have an Engineering or Chemical background will be considered. Please write giving full details of career and present salary, to: The Personnel Officer, BOX B 207, Offices of ENGINEERING.

LUBRICATION ENGINEERS

CENTRALUBE LTD., Lubrication Engineers, require the following Mechanical Engineers, preferably qualified, with heavy engineering and/or sales experience.

Personal Assistant to Chief Engineer, based at Head Office, London.

Area Engineers for Scottish and Yorkshire Areas. Engineers for London Office, N.18.

Full details of age, experience and salary required, in confidence, to MANAGING DIRECTOR, CENTRALUBE LTD., PARK ROYAL ROAD, LONDON, N.W.10. B 253

ENGINEER SURVEYOR

ENGINEER SURVEYOR required for inspection of Cranes and other Lifting Tackle. Must have drawing office experience in design of Cranes and hold National Certificate for Mechanical Engineering. Relief work and in specified areas. Commencing salary, £800. Non-Contributory Retirement Pension etc.—Apply ENG. DEPT., GENERAL ACCIDENT ASSURANCE CORP., LTD., 99 ALDWYCH, LONDON, W.C.2. B 263

ENGINEERING DRAUGHTSMEN

There are vacancies for Draughtsmen at the various Birmingham Works of the West Midlands Gas Board. The posts are on the staff of the Divisional Engineer and offer excellent opportunities for gaining experience in a wide field of engineering activity.

One post is within the salary range of £733 to £927 per annum and candidates should hold a Higher National Certificate in Civil or Structural Engineering or equivalent qualification.

The remaining posts are within the salary range of £629 to £709 or £629 to £813 per annum according to experience. Candidates for these posts should have completed a drawing office apprenticeship or have equivalent experience and have reached at least Ordinary National Certificate level in Civil, Mechanical or Structural Engineering.

Pension scheme and attractive conditions of service.

Applications, stating age, qualifications and experience, should be addressed to MR. J. E. WAKEFORD, DIVISIONAL GENERAL MANAGER, WEST MIDLANDS GAS BOARD, EDMUND STREET, BIRMINGHAM, 3. B 261

DESIGN ENGINEERS

An Engineering firm of repute in the Eastern Counties has vacancies for **TWO EXPERIENCED DESIGN ENGINEERS.** One, age 25-30, minimum qualifications H.N.C. or equivalent. One, age 30-36, minimum qualification graduateship or Associate Membership of Inst. Mechanical Engineers to assume responsible position after acquiring knowledge of Company's products.

Candidates must show ability to produce sound designs for interesting work involving structural as well as mechanical engineering. Experience in the design of medium-heavy mechanical handling and/or construction equipment an advantage.

Attractive salaries to suitable applicants. There is a Contributory Pension Scheme and good canteen facilities.

Write in confidence giving full information about qualifications, experience and salary required, quoting A.6084, to:

WRIGHT ATKINSON LTD.,
Employment Consultants,
70 Queen Victoria Street,
London, E.C.4.

B 229

ERECTION MECHANICAL PLANT ENGINEER

to be responsible for the inspection and maintenance of all mechanical erection plant. This job involves travelling throughout the country. Engineers aged 28 to 35 with at least Grad.I.Mech.E. should apply in detail, mentioning this paper and quoting the reference number 4/60, to The Staff Officer,

WHESSOE LIMITED
Darlington

B 216

BRITISH CONSTRUCTIONAL STEELWORK ASSOCIATION

Applications are invited for appointments to the

DEVELOPMENT STAFF

and to the

BRIDGE DEPARTMENT

Candidates should be young men with some experience in the design and detailing of steel frame buildings with knowledge of B.S.449 or with experience in the design of steel bridges with knowledge of B.S.153. Five-day week and luncheon vouchers. Admission to non-contributory pension scheme after qualifying period.

Apply in confidence to the TECHNICAL ADVISER, BRITISH CONSTRUCTIONAL STEELWORK ASSOCIATION, ARTILLERY HOUSE, ARTILLERY ROW, LONDON, S.W.1, giving fullest details with salary required. B 174

SUB AGENTS

required for heavy civil engineering contracts in United Kingdom, with possibility of overseas work at a later date.

Applicants must have at least two years' experience in similar capacity, and should preferably be qualified Engineers. Permanent positions, pension scheme and good opportunities for advancement.

Applicants, giving full details of age, qualifications and experience, to:—
Establishment Officer,

GEORGE WIMPEY & CO. LIMITED,
27, HAMMERSMITH GROVE, LONDON, W.6.
REF. 867.B.

B 219

AIR PRODUCTS (G.B.) LTD.

ENGINEERING MANAGER

A well qualified senior chemical or mechanical engineer is required to head our engineering department.

He will be responsible to the Managing Director for all the engineering activity of the Company which is engaged on the design, manufacture and erection of low temperature process plant for the chemical, gas and steel industries.

The activities of our well established Company are expanding rapidly. This vacancy offers, therefore, outstanding opportunities for the really ambitious executive engineer.

Applications will be treated confidentially and should be addressed to:

Personnel Manager

AIR PRODUCTS (G.B.) LTD.
St. Giles House, 49/50, Poland Street, London, W.1

B 259

THE ASSOCIATED PORTLAND CEMENT MANUFACTURERS LIMITED

require several

SENIOR AND JUNIOR MECHANICAL ENGINEERING DRAUGHTSMEN

for work on plant layout schemes and details at Head Office, Westminster.

Experience in heavy machinery, plant layout and mechanical handling an advantage. Applicants with H.N.C. in Mechanical Engineering preferred for Senior Posts.

The Company offers good salaries and working conditions, pension fund and profit sharing bonus.

Replies giving particulars of training and experience will be treated in full confidence and should be sent to the following, marked "Personal":—

THE MANAGER,
CENTRAL ENGINEERING DEPARTMENT,
ASSOCIATED PORTLAND CEMENT
MANUFACTURERS, LTD.,
PORTLAND HOUSE, TOTHILL STREET,
LONDON, S.W.1. B 159

PROJECTS ENGINEER

CHEMSTRAND LIMITED

have a vacant appointment in their works at Coleraine, Northern Ireland, for a fully qualified Mechanical Engineer to assist in Plant Development and Improvement Projects under the Engineering Department Superintendent.

Applicants should be in the 25/35 age group and preferably with experience in the chemical or petroleum industries. Qualifications in chemical engineering would be an advantage.

Generous starting salary, pension and life assurance schemes and other big company benefits. Housing is available locally and the company pays joining expenses.

Please apply in confidence to

THE STAFF PERSONNEL MANAGER,
CHEMSTRAND LTD.,
8, WATERLOO PLACE, LONDON, S.W.1,

quoting REF. PCE.2.

B 242

BRITISH OXYGEN GASES LTD.

ELECTRICAL ENGINEER

An Electrical Engineer between 25 and 30 years of age is required for interesting development work in connection with power units and control gear for inert gas welding. A knowledge of electronics is an advantage, and the candidate should possess a degree or H.N.C. in electrical engineering.

TECHNICAL ASSISTANTS

Technical Assistants are also required in the age range 25-30. They should have an electrical background and a H.N.C. in electrical engineering would be preferred. Candidates should have a knowledge of electronics or development experience in industry.

There are good further prospects and very good commencing salaries are offered.

Please reply stating full particulars to

THE PERSONNEL MANAGER,
SPENCER HOUSE,
ST. JAMES'S PLACE,
LONDON, S.W.1.

B 228

CHIEF ENGINEER

A leading British mining company in West Africa requires a Chief Engineer who will be responsible to the General Manager.

This is an important post covering responsibility for the whole of the mechanical and electrical equipment on the surface and underground, comprising treatment plant, 15 MW oil engined Power Station, winders, pumps, ventilation fans, air compressors, mechanical loaders, locomotives and transport fleet.

Applications will be considered from engineers who are members of one of the professional institutions and who are aged 35/45.

Initial salary up to £3000 according to qualifications; non-contributory pension scheme. 15 months' tours followed by 3 months' leave. A suitable house and car are provided and passages paid. Reference number C.53.

Please reply in confidence, quoting reference number, to

Robert Clive (Consultants) Limited

Appointments Consultants,

27, ALBEMARLE STREET, LONDON, W.1.

B 233

AIR PRODUCTS (G.B.) LTD.
INDUSTRIAL GAS DIVISION

GENERAL MANAGER

A fully qualified Chemical or Mechanical Engineer is required to head this newly established division of the Company.

He will organise, manage and control the sale, production and distribution of industrial gases. Applicants must have extensive experience in the sales and distribution of industrial gases or chemical products.

This is a top management position with outstanding opportunities for the right man.

Write to: *The Personnel Manager,*
AIR PRODUCTS (GREAT BRITAIN) LTD.,
ST. GILES HOUSE,
49/50, POLAND STREET, LONDON, W.1.

B 260

COMMONWEALTH OF AUSTRALIA

AUSTRALIAN DEFENCE SCIENTIFIC SERVICE

AIRCRAFT ENGINE PERFORMANCE TESTING.

The Department of Supply, Melbourne, invites applications for the following position:—

POSITION: EXPERIMENTAL OFFICER, GRADE 3.

SALARY: £A1730/1950.

DUTIES: Under direction of a Senior Scientific Officer undertake detailed planning, conduct, analysis and reporting on tests for the measurement of aircraft and engine performance, including necessary instrumentation. Assist as required on investigations involving collection and analysis of performance data. Observer flying as required during conduct of tests.

QUALIFICATIONS: University Degree or qualifications giving exemption from the graduateship examinations of the I.Mech.E., the I.E.E., or the R.Ae.S.

CONDITIONS: The successful appointee to the above position will be seconded to the Department of Air for a period up to five years for duty with the Aircraft Research and Development Unit, R.A.A.F., Laverton, near Melbourne, Victoria.

Where permanent appointment is accepted, the successful applicant will be required to contribute to the Commonwealth Superannuation Scheme.

First class sea or air fares (if first class berths available) for appointee and dependants (wife and dependent children) will be paid by the Commonwealth. Salary payable from date of embarkation.

APPLICATIONS: Forms obtainable from: Senior Representative (AV.46/2), Department of Supply, Australia House, Strand, London, W.C.2, with whom applications should be lodged by 4th March, 1960.

B 247

VICKERS-ARMSTRONGS (ENGINEERS) LTD.,

require

TECHNICAL ENGINEERS

at their Southampton Office

for design calculations in connection with the Dounreay Nuclear Submarine Prototype.

Applicants should hold a University Degree or H.N.C. in Mechanical Engineering. Candidates with Marine Engineering experience (seagoing or construction) are preferred.

In addition to the above,

ARRANGEMENT AND DETAIL DRAUGHTSMEN

are also required.

Salary will be in accordance with age, qualifications and experience.

Applications should be in writing to:

The Manager,
VICKERS-ARMSTRONGS (ENGINEERS) LTD.,
Oak Yard, Hazel Road, Itchen, Southampton.

B 224

A client in the London area manufacturing and marketing a wide range of products based mainly on oils, resins, rosins, bitumens, pitches, rubbers and polymers, requires:—

A WORKS MANAGER

who would be answerable to the Works Director and must be able to act for him in his absence. Must be a man of very strong character, good on human relations, and with technical background. A qualification in industrial management or from a technical institute would be valuable but not essential.

Age range 33-40. Six months on probation at £1500; thereafter not less than £2,000.

Apply in confidence, quoting reference A/M, to:—

THE P.E. GROUP,
12, GROSVENOR PLACE,
LONDON, S.W.1.

B 230

Another opportunity in Iron and Steel

BISRA

RESEARCH ENGINEER

to participate in an ambitious project aimed at the development of new types of rolling mills for the metal industries of the late sixties.

This is a particularly attractive opening for a mechanical engineer in his twenties to exercise his creative abilities to the full and to gain a vantage position in a field of great scope and reward. The important qualifications for success in this job are a good grounding in modern engineering science and an inventive turn of mind. Lack of experience of metals technology is no handicap.

The post is centred in the Association's laboratory in Sheffield with visits to steelworks and contacts with the design and development departments of leading makers of heavy engineering equipment. Initial salary will be assessed according to age, qualifications and experience in the range £950-£1200 with opportunity for rapid advancement by merit.—Applications, quoting "M.W.17," to Personnel Officer, The British Iron & Steel Research Association, 11, Park Lane, London, W.1.

B 254

'Engineering' Appointments Section

ADVERTISEMENT RATES

CLASSIFICATIONS: Public Appointments, Appointments Open, Appointments Wanted.

TYPES OF ADVERTISEMENTS:

(a) "Appointments Illustrated" and illustrated careers advertisements: photographs or drawings may be used in conjunction with type matter.

Rates:	per page (12 in. by 9 in.)	£100
	half page	£54
	quarter page	£29

(b) Semi-display: type matter, with or without surrounding rule, name block or symbol.

Rates:	per page (12 in. by 9 in.)	£100
	per half page	£54
	quarter page	£29
	per single column inch	£2 14s.

(c) Single column "run-on" advertisements: approximately 6 words to the line, 12 lines to the inch.

	Rate per line	4s. 6d.
	(Minimum charge 18s.)	

SERIES DISCOUNTS: 5 per cent. on 6 insertions; 10 per cent. on 13; 15 per cent. on 26.

BOX NUMBER: 2s.

COPY DATE: First post Monday.

BLOCKS: To be mounted ready for printing. Screen 100.

ORDERS TO: "Engineering" 36, Bedford Street, London, W.C.2.

(Telephone TEMple Bar 3663).

Companies

Bid and Counter-Bid for Lancashire Dynamo

Although METAL INDUSTRIES came out with their bid for LANCASHIRE DYNAMO HOLDINGS on a precept shattering day—Christmas Eve—it is now known that their first approach to the Lancashire Dynamo directors was something over 18 months ago.

Be that as it may the Lancashire Dynamo directors, at the latest game in the set, were recommending the rival bid, by ELECTRIC AND MUSICAL INDUSTRIES.

The Metal Industries group extends from electrical instruments, switchgear, other electrical equipment and an electrical subsidiary in South Africa, to engineering companies and electraulic press manufacture with subsidiaries in France and shipbreaking and salvage companies, mostly on the North-East coast.

Electric and Musical Industries, the diverse industrial middle-weight of Hayes, Middlesex, is best known to the public through His Master's Voice records, radio and television. It is a reasonable guess that the future function, though equally busy, of Lancashire Dynamo would be by no means the same once its shareholders have decided.

A statement from Metal Industries, regretting the action of EMI and advising shareholders to take no action on the counterbid as a further announcement was on the way, suggested that a counter-counter-bid was planned.

When it came the raised Metal Industries bid, by market prices after some changeable dealing, was worth something under £12½ million.

BEA's Bright Future

Looking forward from the record BRITISH EUROPEAN AIRWAYS' profit of £2 million, the corporation's chairman, Lord Douglas of Kirtleside, predicts that within the next four or five years BEA will be carrying twice as many passengers and cargoes as at present.

The next few months for BEA will see their longer range jets, the Comet 4B's coming into full fare earning service, plus the Vanguards, successors to the Viscount and the first "second generation" turboprop airliner. Beyond that is the not-so distant prospect of the Airco DH 121.

As with the rest of the major world air line operators, once the corporation has its new capacity functioning its task will be to keep it filled. Up to a point the 1959 performance is some guide.

Passenger-miles flown by BEA during the year rose 18 per cent to 3,200,000, and Lord Douglas attributes this to the low inclusive fares introduced in 1959. This is obviously not a line which can be followed to any serious extent as the great cost of the new aircraft piles up unless the flying habit diffuses much more widely through the public.

Freight carriage increased by 24 per cent. What is wanted here is expansion of cargo moving much more than yet reached, beyond simply those users for whom any other form of transport would lose the freshness of the commodity, whether it be roses from the South of France, orchids or strawberries. BEA might do worse than sell freight space on the desirable achievement of getting the goods there before the competitor.

Traffic and Staff Figures, 1959

	Year ended 31 December, 1959	Year ended 31 December, 1958	Variation, per cent
Capacity ton-miles offered	189,325,000	176,764,000	+ 7·1
Load ton-miles sold	126,444,000	106,175,000	+19·1
Revenue load factor	66·8 per cent	60·1 per cent	+11·1
Passengers carried	3,207,000	2,760,000	+16·2
Passenger miles flown	1,130,514,000	961,242,000	+17·6
Passenger load factor	68·6 per cent	62·3 per cent	+10·1
Freight ton-miles	13,852,000	11,142,000	+24·3
Mail ton-miles	4,010,000	3,965,000	+ 1·1
Average staff numbers	12,008	11,485	+ 4·6
CTM per employee	15,800	15,400	+ 2·6

No Merger at Napier

D. NAPIER AND SON, the aircraft engine firm, has explained that it is continuing to operate independently within the ENGLISH ELECTRIC GROUP framework. The company is not affected by the air industry merger ENGLISH ELECTRIC-VICKERS-BRISTOL.

This is because although Napier are part of the English Electric Group it is not part of ENGLISH ELECTRIC AVIATION Limited, a subsidiary formed by the group last year for aircraft and guided missile activities.

Napier last year pulled off a useful break into the United States domestic airline world with the Eland engined Convair conversion.

New Names and New Companies

Simmonds

With an eye not only on the markets of the European Economic Community (the Six) but also on the nations of Eastern Europe, SIMMONDS AEROCESSORIES, of Treforest, Glamorgan, South Wales, have formed a company in Western Germany in association with MECANO-BUNDY GmbH. With its headquarters at Heidelberg, the new company will make and handle the sales of Spire Speed Nuts and other fastenings.

Mecano-Bundy is itself jointly owned by MANNESMAN AG, of Düsseldorf, one of the world's largest tube makers, and the BUNDY TUBING company of America. The new company is called MECANO-SIMMONDS Gmbh. The ultimate aim of the new company, which has bought additional factory space in Heidelberg is to sell in every Common Market country, except France, and to develop markets in Eastern Europe. Simmonds are a FIRTH CLEVELAND subsidiary.

Spire Speed Nuts and other Simmonds fastenings are already used in a great variety of cars, radios and television sets and domestic appliances. They have a useful export performance and are made by an Australian subsidiary.

Microcell

The commercial engineering division of MICROCELL is to be formed into a subsidiary known as MICROCELL ENGINEERING. It will make aircraft passenger seats and components and also seats for road and rail vehicles and for ships.

Weir Group

W. R. SKINNER, the London and South East England service subsidiary of the G. & J. WEIR GROUP, of Glasgow, has changed its name to WEIR, DRYSDALE SERVICE (LONDON).

The Power Behind Production

The electricity industry now produces seven times more electric power for each man employed than it did 33 years ago.

Mr. Clifford R. King (inset), chairman of the ELECTRICITY COUNCIL, telling this to the annual lunch of the BRITISH INDUSTRIAL MEASURING AND CONTROL APPARATUS MANUFACTURERS' ASSOCIATION, explained that in 1927 the ratio of manpower to output was 2·8 per thousand kW. By the adoption of modern instrumentation the ratio was now down to 0·4 per thousand. The Electricity Council chairman emphasised the key role which instrumentation had to play in the growth of nuclear power over the coming years.

Mr. V. D. MacLachlan, chairman of BIMCAM, pointed out that the export figures of the measuring and control apparatus industry were above the national average. There can be little argument with the chairman's next point that the moves towards greater leisure and the upward surge in consumer demand will only be met by a greater use of instrumentation in industry.

Since 1944, the founding year of BIMCAM, the annual turnover of the industry has increased from £3 million to £35 million.

From Boxkite Biplane to Bristol 188

In the space of 50 years the BRISTOL AEROPLANE company has gone all the way from the string-and-stick biplane of before the First World War to the 100,000 h.p. ramjet.

As a company, Bristol has moved up from a house and some sheds on two acres north of Bristol to being a modern holding company with its BRISTOL SIDDELEY ENGINE company, one of the largest aero-engine makers in the world, part of the HAWKER SIDDELEY industrial empire and its BRISTOL AIRCRAFT company a part of the new aircraft group ENGLISH ELECTRIC AVIATION-VICKERS-ARMSTRONGS (AIRCRAFT)-BRISTOL AIRCRAFT. In association with the AEROJET GENERAL CORPORATION of California, BRISTOL AEROJET is pursuing rocket development with solid fuel.

A characteristic of the Bristol history—its 50th anniversary comes up on 19 February—has been its speed in getting from the idea of an aircraft to seeing the thing take off. A few months after the company's foundation its first plane, the Bristol Boxkite biplane, was in production. In September, 1910, it made the first military flight in the world when the Boxkite was used for reconnaissance by the British Army in manoeuvres on Salisbury Plain.

Overseas sales efforts, prophetic of later years, began almost at once. Bristol aircraft were sold to Russia, Roumania, Bulgaria, Turkey, Italy, France, Sweden and Spain. So large a part of pilot training was conducted by Bristols that when war broke out 80 per cent of British pilots ready for service were Bristol-trained.

The whole aircraft industry has suffered, or gained, by crash programmes of acceleration as wars have overtaken the politicians. The First World War brought explosive development to Bristols. Its best known contribution was the Scout and the most far reaching the M1C high-wing monoplane fighter, which came late in the war, and the four engined triplane bomber the Braemar. The Braemar developed into the Pullman, the first fully enclosed airliner.

A typically bold Bristol decision followed the Armistice at a time when the aero-engine market looked like being flooded with war-surplus power units. The Bristol Aero-Engine department was formed. With the nine-cylinder air cooled radial Jupiter it rapidly left the war surplus supplies obsolescent and far behind. The supercharged Pegasus that came later under the leadership of Sir Roy Fedden, who was chief engineer from 1920 to 1942, was as famous as the Bristol Bulldog that went into production for the RAF and other forces. Until orders for the Bulldog came along the aircraft division was suffering from a serious lack of work.

Bristol startled the cavalry-and-puttees Service chiefs in 1935 with a stressed skin monoplane that flew faster than 300 m.p.h. This was the year that the Government belatedly set about a rapid strengthening of the RAF. Using car factories and other places the "shadow" scheme was getting moving in 1936 and Bristol engines—the Pegasus, Hercules and Centaurus among them—were demanded in volume. Blenheims, Bombay Transports, Beaufighters were all part of the war's history. Bristol stuck to their swift methods in getting the Beaufighter into squadron service a year after its first flight.

The company has not had the far reaching rundown of its activity suffered in the '20's. The revolutionary Brabazon, the commercially more successful Britannias, with 80 sold to six airlines and Transport Command, and the Proteus free turbine and Olympus pure jet kept the firm in the first rank.

Much of Bristol's activity is now well back behind the security screens. The Bristol Siddeley BE53 and BE58 ducted fan engines should have an important bearing on aviation developments. The type 188 supersonic research aircraft is one of the keys to the problems of flying at speeds in multiple Machs.

Air Conditioning as a Paying Proposition

Productivity in printing, as in other industries, is governed to quite a large extent by the air conditions of the factory. Both the relative humidity and the dry bulb temperature should be controlled.

The installation of full-scale air conditioning plants in printing works in Great Britain is still comparatively rare. At first sight, this may seem strange in view of the urgent need to modernise and speed up production methods in the printing industry. There are probably two reasons for this situation. Firstly, the inherent ability of the British to "make do" and put up with unsuitable conditions, coupled with an obstinate and completely false belief that the climate never blesses us with high summers, and that, therefore, air conditioning is a luxury.

Secondly, some people will argue that many air conditioning plants fail to prove themselves worthwhile. This situation again arises from the inability to admit that high summers are quite usual, consequently many plants are installed without cooling systems. These plants are usually simply hot air humidifying systems and do not provide control of conditions when it is most needed, that is, during hot and humid periods. Furthermore, many other plants have been installed on the assumption that the control of relative humidity is the only requirement whereas, in fact, satisfactory results cannot be obtained without also controlling the dry bulb temperature. It is argued that in order to obtain satisfactory, efficient and economic results, it is absolutely essential to control both the relative humidity and dry bulb temperature, and in addition to choose carefully the most suitable control points.

Ideally, the control range should be between 52 per cent and 56 per cent relative humidity together with a dry bulb temperature of between 67 and 69° F. These conditions should be maintained throughout the year, except during periods when the external temperature exceeds 78° F, when a small rise in internal dry bulb temperature is desirable for reasons of economy and comfort; under such conditions the relative humidity may fall slightly to advantage. The control of conditions around these ranges provides for an economical plant with pleasant working conditions. Such a plant should cover for external conditions from 30° F dry bulb and 28° F wet bulb up to 82° F dry bulb and 67° wet bulb, subject to slight variations to suit local conditions. Although variations to suit local conditions may be slight, they are nevertheless very important: failure to take this item fully into account may result in inability to control accurately near the outside limits of plant design or, alternatively, capacity may be installed to cope with conditions that will not arise.

The control points must be determined in relation to the condition of the stock arriving from the paper suppliers and they must ensure that, in its progress through the factory, the paper tends to lose moisture, this being the condition most conducive to easy handling.

It is maintained that, with control of dry bulb temperature to within ± 1° F, the relative humidity control range may be allowed between ± 4 per cent, while still maintaining satisfactory paper handling. With very heavy papers, it may even be found possible to extend the working range of control, although the personal comfort considerations must be taken into account with widely fluctuating control limits.

The area surrounding the primary paper slitting, cross-cutting and maturing sections should be controlled at a slightly higher relative humidity, this being about 4 per cent above the press room, while the dry bulb temperature remains the same. As previously stated, this will enable the paper to be in condition to lose moisture to the room atmosphere and consequently it will tend to repel the effects of damping on the printing process.

It is essential to avoid the shock effect of bringing the paper stock into an atmosphere which is greatly out of balance with the moisture content of the paper, as it may take several days of maturing for it to achieve reasonable equilibrium with the factory atmosphere and to be in a suitable state for stable trouble-free handling. While it is possible to choose control conditions outside these suggested ranges, such a course should be approached with great caution, as other problems such as static and operator comfort may prove very difficult to overcome, and running and capital costs for the plant may be greatly increased.

The actual design of air conditioning plants can take many forms; but to obtain the best results a washer type plant operating on a fixed dewpoint basis, with heating and cooling to the sprays, together with tempering heater batteries, has a great deal to recommend it, particularly if the latest electronic control methods are used.

A plant of this type has recently been designed and installed by Carter Thermal Engineering Limited at the new factory of Kalamazoo Limited, the Birmingham printers. This plant controls conditions to 54 per cent relative humidity ± 2 per cent and 68° F ± 1° F in a single-storey northlight building of approximately 50,000 sq. ft.

The plant was designed with an emphasis on efficiency and operating costs. It incorporates variable speed drives to two aerofoil centrifugal fans, and an air control economy system. As a result, the overall running costs of this plant are reported to be some 35 per cent lower than those of a conventional dewpoint control plant.

In the plant, air is drawn through a double spray bank washer where it is automatically adjusted to the dew point setting by heating or cooling the sprays. Direct control of the washer tank water temperature is not employed in order to give a rapid response to changing conditions of the entering air. On leaving the washer, the air passes through main heater batteries, which automatically compensate for changing external conditions, and is delivered by two airfoil centrifugal fans into the main delivery trunking. Branch ducts are taken from this main trunking into each factory bay. Tempering heater batteries are installed in each branch duct to ensure that there is precise control of shop conditions.

The main trunks and branch duct heater batteries are all contained within a special service duct, which is installed centrally across the factory area. This service duct also acts as a return air trunking, the return air being drawn in through adjustable grilles situated along the sides and base of the duct (see Fig. 1).

Conditioned air is delivered at high level into the working area by suitably placed Airmaster diffusers. The air velocities throughout the whole system have been kept low to provide silent draught-free distribution (see Fig. 2). The total volume of air delivered is varied by adjusting the fan speeds to suit load conditions. A maximum of 130,000 cu. ft per min is available.

Water cooling is catered for by a 150 h.p. compressor refrigeration plant with automatic capacity control. This cooling plant is brought into action automatically as required, the capacity being adjusted to suit the load. Two pumps in parallel are employed to feed the sprays and scrubbers and also to serve the cooling water system, thus eliminating the need for separate pumps and contributing to the running economy.

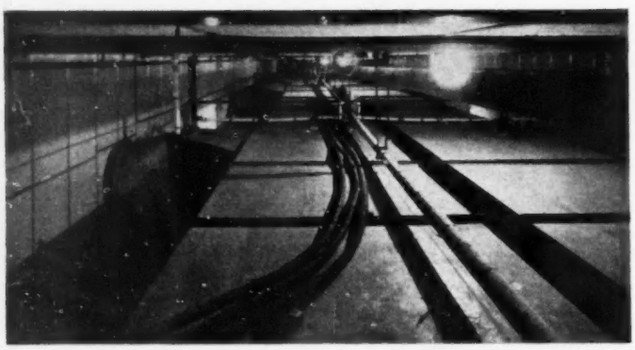


Fig. 1 (above left) This service duct is installed across the factory area and contains the main trunks and duct heater batteries.

Fig. 2 (above right) Airmaster diffusers situated above the working area. The air velocities in the system are kept down to provide silent draught-free distribution of conditioned air.

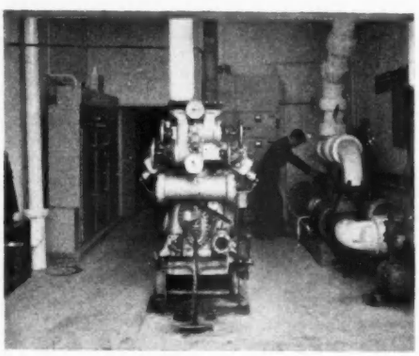
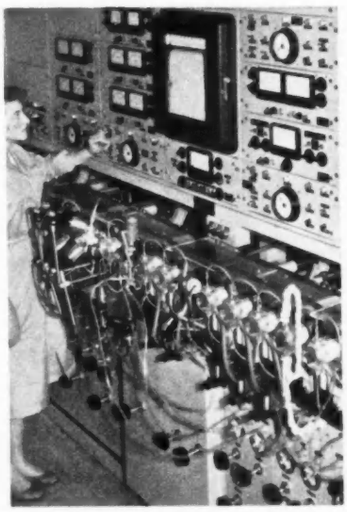


Fig. 3 (right) The layout of the compressor room showing the refrigeration compressor, the end of the washer with pumps and distribution headers, and the power control panels.

Automatic Transistor Manufacture

The accompanying illustration shows a part of an automatic transfer line used in transistor manufacture at the Cheney Manor plant of Semiconductors Limited. The equipment was built by the special purpose machinery division of the Plessey Company of Ilford, Essex.

It was designed to suit the company's requirements following experience with original Ameri-



Automatic transfer line for transistor manufacture.

can machinery produced by their associates, the Philco Corporation of Philadelphia. It includes many new features and has a total of 22 operating heads, in place of the previous nine. This increase in the number of heads enables more complicated devices, such as micro-alloy diffused transistors, to be made automatically. Previously, some of the traditional operations necessary for the manufacture of this type of transistor needed separate hand-operated machines. In addition, the longer processes have been broken down into shorter cycles, thus increasing the rate of production.

Collecting Data from the Production Line

The IBM 357 data collection system has recently become available in the United Kingdom. The system provides a network of reporting stations on the production line, through which information about work in progress is transmitted directly to a central data-processing point. It can be used in assembly-line operation, job recording, and for such tasks as the operation control of vehicle pools, railway-wagon classification, the control of test operations, and for all systems which involve the movement of men or materials. It is claimed that the system makes it possible for management to receive final reports at a greater speed than has hitherto been possible.

The operation of the system depends on the insertion by the employee of prepunched cards into an input station in order to give up-to-the-minute reports on the job in progress. From information fed into the input unit, a punched card is produced automatically and is available for immediate use in a data-processing system.

It has been tried out by the Boeing Air Company, where it provides information on progress in all sections of the plant. Delay in transmitting important data, and the consequent loss of much of its value and timeliness, is being largely eliminated by this means. For instance, executives are enabled to obtain such current information as where an order stands at any moment in the production cycle, the stage of each component or sub-assembly, and which machine tools are in operation or temporarily down. Managements accordingly can plan and maintain production schedules, avoid bottle necks and quickly see the position in respect to factory costs.

The data-collection system consists of an input station, into which cards are fed, and which is similar in size and appearance to a time clock, and a keyboard which allows the sending of additional variable information. Up to 20 of these stations can be connected to a single output station. The output station is situated in the data-processing room, where it translates the data from the input station on to punched cards. A control unit controls the sequence of data transmission from the various input stations, and also selects the required information as needed. A clock read out enables the time to be punched automatically into the output card.

Data Processing in Chain Stores

Electronic data processing equipment which can deal automatically with all invoicing, stock control, branch accounts, supplier's accounts and company payroll calculations associated with chain store organisations, is now being marketed in this country by De La Rue Bull Machines Limited. For a chain store organisation with 500 branches dealing with 4,000 stock items through six main departments, a complete installation would consist of a magnetic reader, a magnetic drum, an electronic calculator and a high speed printing tabulator.

In such an organisation, the manager of each retail branch is supplied with a special block of cards on which is reproduced the full list of goods stocked at the company's main warehouse. When he wants to make an order, he specifies in pencil the quantity required by marking the appropriate numbers against the particular items. For articles of variable weight, such as meat, fruit and vegetables, the orders are written on special cards which are completed by the person making up the consignment.

When the order made out by the branch manager reaches his head office, it is put into a magnetic reader which automatically punches holes where marks have been made to indicate quantities. This operation can be done at a speed of 4,500 single-sided cards per hour, or 2,250 double-sided cards per hour. After this, the cards are ready to be used for calculations and for the printing of invoices and other documents.

Before automatic printing is begun, it is necessary to record certain essential information on the magnetic drum of the Gamma electronic equipment. This information would include the number and description of the item, the delivery unit quantity, the unit price and weight, the stock position and re-order level. The magnetic drum can receive at one time instructions for up to 1,800 items at a speed of 150 item cards a minute. If the number of items exceeds 1,800, a second operation is necessary.

As the order cards pass through the tabulator, it checks each item ordered and selects the relative description and price on the drum while the calculator simultaneously determines the total to be printed on the same line. At the same time, the quantity invoiced is deducted from the original stock level and totalled for the delivery note. When the invoices for one batch are completed, the consignment note is printed automatically. After a line has been completely dealt with, the new stock position is also printed automatically, with an indication of the articles to be re-ordered. When the re-order level is reached, the mark "R" is printed. If the order is in excess of current stock the words "not available" are printed automatically on the consignment note.

On completion of each invoice, summary cards and group cards (on which the turnover is shown in groups of goods for accounting purposes), and invoice cards for branch accounting are all punched automatically.

For chain store organisations smaller than the one described, a less elaborate system is required. The equipment is not confined only to invoicing work.

Counting Batches of Sheet Material

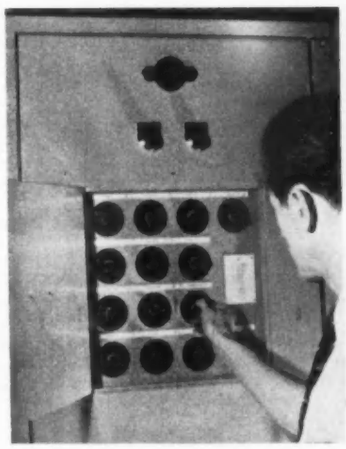
Two companies have recently combined two of their standard products. The companies are the Electronic Machine Company Limited and the Soag Machinery Company, and the products are the Batchcounter (ENGNG., 2 Oct. '59, p. 299), and the Soag Slipinserter. The combined unit counts sheets of any material passing through it and inserts a slip of paper into the pile when a preset batch total is reached. The required batch is selected on the dial of the Batchcounter. The photo-electric cell and light head of the Batchcounter are fitted on a machine where a definite gap between each sheet passing through the machine is located, the Slipinserter being mounted at the pile delivery unit.

The unit runs off the normal 200/250 V a.c. supply and has an adjustable height of between 3 and 5½ ft. It inserts a slip 4½ in long by ¾ in wide at speeds of up to a maximum of 30 insertions per minute, different thicknesses of slip being available for varying applications. The overall dimensions of the complete unit are 6½ ft high by 4 ft wide.

Machine Tool Control by Uniselectors

By using a uniselector stepping device in the construction of six milling machine panels for the Humber car factory, Brookhirst Igranic Limited, Bedford, are providing CVA Jigs, Moulds and Tools Limited—the makers of the machines concerned—with an alternative method of control.

The machine in question is divided into a number of phases from 1 to 14 on Duplex



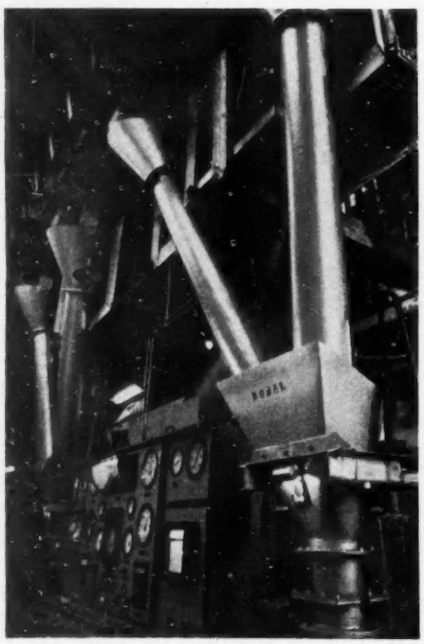
Milling machine control panel.

spindles such that, by setting each phase selector switch, a varied number of machine cycles become possible. This new method obviates the use of a large number of latched-in relays or the "Woodpecker" selective device used in blast-furnace controls. At the start of each movement, the uniselector moves to the next position and applies a working potential, with the result that, upon completing an operation, the next in sequence will start up.

The benefits of this system include a reduction in size of the controls and a quicker selection of machining cycles, apart from the opportunity of handling more than one type of component on the machine.

Aluminium Chute Stops Coal Blockages

In Britain's coal-burning industries, steel chutes deteriorate rapidly because of the combined action of corrosion and erosion, and their life varies between 2½ and 5 years. Steel chutes of the " packed " type also have the disadvantage that they suffer frequent blockages due to the rough interor surfaces. With the present trend towards the increasing use of pulverised fuel units, these blockages cause loss of ignition, and result in damage to the refractories and, of course, loss of output.



(Left) These aluminium alloy coal chutes and hoppers are part of a bank of 14 at the CECB's power station at Earley, near Reading.

(Below) The action of the Coal moving through the hoppers is to polish the interior until it shines like a mirror and offers little resistance to movement; the risk of the hopper choking is thus reduced to a minimum.

At a large electricity generating station at Cowes, Isle of Wight, it was noted that, even after quite long periods among the coal stocks, certain aluminium alloys remained remarkably free from corrosion. This observation led the station superintendent at that time, Mr. R. G. Henbest, to conduct experiments to determine the benefits, both as regards performance and cost, of using aluminium for coal chutes. In 1949 an experimental aluminium alloy section (Noral 65ST supplied by Northern Aluminium Company Limited) of riveted construction was used in a new steel coal chute and examined annually over a period of five years. The steel sections were replaced in 1954, but the aluminium section remained in service and continued to provide valuable information for subsequent applications of a similar nature. Between 1949 and 1954 the aluminium section showed a total weight loss of 5 lb (about 8½ per cent) through erosion.

A significant development during the experiment was that the flow of " green " coal through the chute caused the interior surface of the aluminium section to take on a mirror-like finish as compared with the rough surface of the steel sections.

This feature was later used to good effect at the Central Electricity Generating Board's generation station at Earley, near Reading, where frequent blockages in steel coal chutes feeding the pulverising plant caused output losses, together with the attendant difficulties associated with re-ignition.

To solve this problem, an experimental aluminium chute, designed in conjunction with Northern Aluminium Company Limited, was fabricated by Lovejoy Brothers of Theale, Berks, using ¼ in thick Noral B54SM (BS NP5/6M) alloy plate in an all-welded construction. The chute was installed in September, 1953, and the experiment proved successful for it resulted in the subsequent replacement of the remaining 13 steel chutes in the station's boiler house with chutes and hoppers of aluminium.

The first chute has now been in service for over 28,300 hours and has conveyed more than 60,000 tons of coal from the bunkers to the pulverising plant. It has already outlived its steel counterparts without showing any appreciable signs of wear, and it is estimated that its life will be at least double that of a steel chute. The aluminium chute costs about the same as a similar mild steel one but, as experience has already shown, its advantages balance the cost considerations.

Automatic Mail Transfer System Under Brussels

An automatic underground postal service operates between Brussels South railway station and the Post and Telegraph Offices about a quarter of a mile away. Mail is put into a lift at one end of the line, is automatically conveyed to an underground train, carried to another lift, and deposited on the delivery floor of the other terminal. The cycle repeats about 100 times a day and has operated satisfactorily for over a year.

The installation was opened in October, 1958, to carry " express " mail to and from the new sorting office at South Station—itself greatly extended in recent years. The only available route for the link, if excessive capital outlay was to be avoided, was a tunnel used by the Belgian National Railways for heating their offices. A passage measuring 800 mm by 600 mm (31½ in by 24 in) was available. It included a dozen curves having radii of only 2·5 metres. The time that could be allowed for a complete round trip, including loading and unloading, was 10 minutes.

An electrically driven vehicle carries the mail through the tunnel. A removable container forms the centre of the vehicle and at each reception point the vehicle runs into a lift shaft where the container is removed and drawn up to the floor above. There are, in fact, three reception points: the sorting office at Brussels South, the Post Office, and the Telegraph Office. The last two stand together in Place de la Constitution.

The train calls at each reception point in turn. A light flashes and an audible signal attracts the attention of an attendant when the container arrives at the top of the lift. The signal sounds until a door giving access to the container is opened. When the container is emptied, reloaded, and the lift door closed, it is automatically transferred to the next reception point.

Two main switches control the operation. One is the system on-off switch. The other is a switch that brings the Post Office station in or out of action, as this office is closed at night and during holidays. In case the second switch has been forgotten by the staff when the Post Office is closed, the container does not bother to wait longer than 15 sec. If its door has not been opened by this time it goes on its way.

Ateliers de Constructions Electriques de Charleroi constructed the system in conjunction with La Brugeoise et Nivelles Company, the Jaspar Company of Liège, and the Bell Telephone Company.

The 180 mm gauge track has two steel running rails and a central copper-plated steel rail. Insulated sleepers are used. A separately excited motor (0·5 h.p., 3,000 r.p.m.) drives a set of bogies, the field being supplied with a constant direct current at 220 V through the centre rail and one running rail. The armature is fed from the two running rails with a variable voltage from a Ward-Leonard generator driven by an induction motor. The same generator operates the three lift motors as well. Relays and magnetic amplifier units monitor and programme the progress of the container.

Speed on the straight sections of the track is fixed at 4 metres per second. On the bends it reduces to 2 metres per second. At stops the vehicle slows down to 0·2 metres per second to enable it to reach its desired position with an accuracy of 1 cm. These variations only call for small variations in tractive effort; but this is not the case with the lifts. There large fluctuations in torque are necessary for the transition between the normal speeds of 1 metre per second and the approach speed of 0·1 metre per second. Magnetic amplifiers are used to regulate this operation. A further unit compensates for the different voltage drops of each lift and also for the variable voltage experienced by the vehicle.

The speed of the vehicle is too high for direct mechanical operation of switches without the danger of rapid wear. A relay using magnetic detection was therefore designed, and has given satisfactory operation throughout the time the train has been in service. The track relay consists of a C-shaped iron core wound with a coil. The air gap is uppermost and intercepts the flux generated by a similar core and coil energised on the underside of the vehicle. The air gap is about 20 mm and a transmitter length of 400 mm produces (at a speed of 4 metres per second) an impulse of 0·1 sec duration. This is adequate for opening or closing an independent relay whose operating time is only one-quarter of this figure.

By means of the track relays, the vehicle controls its own acceleration—at the curves and at the stops. The same type of relay is used for signalling along the whole length of the track, and in all 44 of such relays are used. Following these signals assiduously, the vehicle travels over 18,000 miles a year. ACEC consider more complex automatic systems are quite feasible.

Short-circuit Testing

Since 1950 there has been an increase in the variety of electrical switching equipments which operate in series with fuses and fuse-links. In these equipments the circuit-breaker operates up to a prescribed limit of over-current; above this the fuse or fuse-link takes over the full breaking capacity of the equipment. In view of this increase and of the experience gained in short-circuit testing of the type of equipment mentioned, the Association of Short-Circuit Testing Authorities (Inc), 36 Kingsway, London, WC2, decided to review the rules set out in ASTA publication No. 9, of 1950.

A new publication, ASTA No. 22, has now replaced the earlier one, and takes into consideration high-voltage automatic fuse switches. To enable the rules to be applied, the types of equipment are defined, together with currents, and symbols used in testing.

In the publication, rules are given for the identification of apparatus, including the provision of general assembly drawings, and the information which is required to be supplied to the testing authorities is specified in detail.

Among the items specified by ASTA it is laid down that the testing authority shall be responsible for ascertaining that the drawings and schedules of information are a correct representation of the apparatus, but not for the accuracy of detail drawings. Oscillograph records must be kept of all short-circuit operations, and photographs of the contacts after test are required. Other photographs are desirable but not obligatory. A description of the performance and condition of the apparatus before, during and after each test shall be issued by the testing authority.

Shrink Fitting with Liquid Nitrogen

Shrink fitting is very old. Originally, of course, it was always done by heating the "outer" component to expand it, and letting it cool after forcing it into position on the "inner" one. This has the obvious disadvantage that distortion may occur in the heated component, and, if it is highly finished, oxidation may damage it as well. Some rectification is often necessary, therefore, when shrink fitting is done by heating.

In recent years both distortion and oxidation have been obviated by shrinking the "inner" component by means of liquid gas, and this method is now routine in many branches of industry.

A shrink fitting operation that was carried out recently in Glasgow used liquid gas, and is unusual because of its size. A guide stalk weighing four tons for a 12,000 ton trimming and bending press was shrunk by means of liquid nitrogen to enable it to be fitted into its cast steel housing.

To use the older method for the operation it would have been necessary to heat the casting for up to eight hours, and distortion would almost certainly have taken place. Instead, the guide stalk was shrunk, using 45,000 cu. ft of liquid nitrogen supplied by British Oxygen Gases Limited. In this way there was a time saving of four hours in the operation, and neither component was distorted at all.

Flying Weather Laboratory

With the object of obtaining global weather data for improved forecasting, the Bendix Aviation Corporation and the Boeing Airplane Company have cooperated in the production and testing of a flying laboratory. Testing was carried out by the two companies in cooperation with the US Air Force, Navy and Weather Bureau. Four Boeing 707 aircraft, specially modified, carried the test apparatus over some 7,000 miles of routes at altitudes up to 45,000 ft and close to the speed of sound.

The equipment is designed on a module basis, which enables certain instruments to be installed in other military and civil aircraft to supplement the information obtained by the specially designed flying weather stations. During the test flights the apparatus collected such data as pressure, temperature, dew point, icing rate, wind speed and direction, solar and terrestrial radiation, atmospheric electricity and nuclear radiation. Information obtained was processed on board the aircraft by electronic computers. In its production version, the system would radio information continuously to a ground communications network.

Information about conditions below and above the flight path was obtained by "dropsondes" and rockets. Dropsondes are parachute equipped instrument containers dropped in flight which radio data from the lower atmosphere to the aircraft. Rockets sent to a height of up to 170,000 ft from a ground base radioed weather information to the aircraft from higher levels.

The tests showed the feasibility of a global weather reconnaissance system operated by flying laboratories. Data monitored continuously from over the oceans and the Polar regions, where the weather is being "made," would improve forecasting.

Gas Cutting for Merchant Seamen

In the event of fire most merchant ships have only an electric drill with which to cut through steel bulkheads; and for severing cables in emergency the usual equipment is a saw or a hammer and chisel. Oxy-acetylene cutting equipment has proved of great value in ships of the Royal Navy, and a "Saffire" gas cutting and welding outfit has now been installed in HMS Worcester, the training ship moored in the River Thames off Greenhithe. HMS Worcester trains cadets mainly for the merchant service, though selected cadets are prepared for entry into the Royal Navy.

Senior cadets undergo a ship's safety course, which includes fire-fighting and emergency repair work. Cutting equipment is used extensively. The "Saffire" outfit, presented by British Oxygen Gases Limited, will be used in this part of the training programme.

Subscriber Trunk Dialling Extends

Evesham, Worcestershire, telephone exchange has been converted to subscriber trunk dialling (STD); it is the third GPO exchange to be so equipped, the other two being Bristol (Central) and Bodmin, Cornwall. At Evesham, the equipment is different from that installed at Bristol, though its principle of operation is the same.

Development work on the group routing and charging equipment (GRACE) which makes STD possible, was along parallel lines using three techniques; electromechanical, electronic and magnetic. Bristol exchange is equipped with the electronic system, which will also be used in other large centres. The magnetic drum type is at present only suitable for very large centres such as London and Birmingham.

For the smaller centres the electromechanical type is most suitable, and this equipment has been installed at Evesham exchange serving 1,300 subscribers. Developed by the GPO in conjunction with the General Electric Company Limited, and manufactured and installed by GEC, the equipment employs some well-tried techniques.

Relays and uniselectors mark, hunt, switch, store information and pulse-out charging and routing information to other automatic equipment used in setting-up trunk calls. There are two main sections: the register, which receives and stores the digits dialled by the subscriber, and sends out the necessary charging and routing pulses to set up the call; and the translator, which identifies the codes dialled, and provides charging rate information and translated routing digits. A very small number of translators serves the need of a much large number of registers.

In practice, a translator is "seized" by a register when information is wanted from it. While the register is acting on a piece of information, the translator will be dealing with the demands of other registers in cyclic order; its speed of operation is such that the setting-up of a call is not delayed by non-availability of a translator.

Inexpensive Fire Protection

Although there are many types of equipment available to detect and extinguish fires, there is still scope for an effective and reliable system which will cover large areas at economic cost. This applies particularly where the areas are infrequently visited, as in some large warehouse premises, or where the building does not lend itself to conventional methods of protection.

To meet this need, Photoelectronics (MOM) Limited, Oldfields Road, Sutton, Surrey, have developed and marketed a balanced beam fire alarm of very high sensitivity. It consists of a pair of light beams, projected across the area to be protected, just below roof level. These two beams fall on to photo-cells, which, by means of a control circuit, are interlocked and balanced. Thus, any variations in light level due to varying daylight, fog or artificial light, affect both cells equally and the effect is balanced out so that nothing happens. If, however, a fire starts, smoke puts one beam or the other out of balance, and, by means of a relay action, an alarm system is set off, extinguishing apparatus is brought into operation, or both can be brought into action simultaneously.

This method of fire detection is particularly sensitive to smoke, and gives warning within seconds of the first smoke, even before flames appear. It is, of course, entirely independent of temperature rise.

Checking Bus Route Loading

Experimental equipment fitted to a London Transport double-deck bus is recording automatically the passenger loading as the vehicle proceeds on its normal service. The equipment was devised by the West Yorkshire Road Car Company Limited, but has been modified by London Transport, who are using it to provide information about loadings on country routes. Subject to satisfactory operation, the bus will be transferred from Staines garage, to which it is at present allocated, to other garages for loading investigations on other of their country routes.

Under each seat is a plywood flap, hinged at one side and arranged to operate a micro-switch on the opposite side. When a passenger sits down, the flap is depressed and the switch operates; the apparatus is set to operate at a pressure of 14 lb, to obviate any risk of recording the placing of parcels on the seat. A recording ammeter converts the electrical impulse sent by the switch into a continuous record on a paper roll having a time base. A special battery mounted under the chassis with the recorder provides the current.

The apparatus records the total number of seated passengers at any particular time, and while it does not indicate the points on the route to which the particular loadings apply, this information can be deduced from the record, allowance being made for late running.

On the Shelf

By Frank H. Smith

Some of us librarians get inquiries from patent people asking when a certain book was received in our libraries. This stems from the necessity to establish the accessibility to the public of a book which may be rare or of so limited an appeal that it is not generally available. My own library is one of those that is theoretically available only to members but bona fide inquirers can also use it and, in fact, bona fide has a pretty wide interpretation. I wonder how this stands up to the patent requirements? Then again, there are libraries which are tight about non-members users but will lend through the National Central Library. Does this make an item available to the public?

Skyliner incorporating Plane Facts appeared as No. 1 dated autumn, 1959. It is produced and edited for the flight operations department of BOAC but deserves a wider public. Maybe, since it has 2*s* on the cover, you can get one if you want it. Try Derek D. Dempster at 73 Eccleston Square, London, SW1, especially if this type of article appeals to you: " Some simple facts about tyres," " Some notes and sketches on the Vickers VC10," " Aerodynamics on the fringe of space."

Slight startlement is what I experienced at a paper-title in the Sept.-Oct. number of *Journal of the British Interplanetary Society*. " Basic Design Criteria for Moon Building " struck me as a bit ambitious but on looking beyond the index I find that this is not a case of building a moon but only the design of buildings for those who may be stationed on the moon. Come to think of it, one is not much more ambitious than the other. But it does show the dangers of indexing by title only, doesn't it?

The Coal Tar Research Association (I use their soap) and the British Coke Research Association jointly announce production of a translation of the Russian *Koks i Khimiya* under the title *Coke and Chemistry USSR*. Any inquiry should go to Information Officer, British Coke Research Association, Coke Research Centre, Chesterfield, Derbyshire. One thing about Russian coke is that it glows red, which is more than can often be said for some coke I know.

Have only just heard of the 21 December publication (and if they read this let 'em take note) by Chapman and Hall of *Extractive Metallurgy* by Newton at 78*s*. And when I say " only just heard," let me explain (allowing for publication delays) that that was the 11 January, which isn't much good, really, to a fellow who likes to tell his readers of what is coming and not what has gone.

The Chinese journal *Scientia Sinica* in its November issue celebrated with special contributions to the decennial anniversary of the People's Republic of China. With charming modesty the first article opens " The industrious, brave and clever Chinese people created a glorious culture in ancient China and produced many distinguished men of science." But all this deals with the period up to about 203 AD and they admit that they tended to lag a bit after that. The last ten years is showing improvement, of course.

Early in February appears the *Public Relations Directory*. I think the title explains itself. It is, of course, a directory of all those people who publicly relate, press and information officers, associations and the like and all for 30*s*. Apply to 79 Wigmore Street, London, W1.

The US Government Printing Office's latest list contains a four-part item called *The Crimes of Khrushchev*. Just the thing to bind in vellum and give to visiting statesmen.

Here's another for Oxford: helibarge. *Aviation Week* for 14 December, 1959, described the combined use of helicopters and balloons whereby the rotator increases its lift by 5 to 10 times. The two together make one helibarge.

From One Medium to Another

Heat and Mass Transfer. By E. R. G. ECKERT. Part A: Heat Conduction and Appendix of Property Values. By ROBERT M. DRAKE, JR. (Second edition of " Introduction to the Transfer of Heat and Mass ".) *McGraw-Hill.* (97*s*)

Distinctly fundamental rather than practical in its approach, this book should mainly be of value to research workers in the heat-transfer field and those dealing with new or unusual heat-transfer problems. It forms part of the McGraw-Hill Series in Mechanical Engineering, and following the general practice of the series, an extensive (though not complete) nomenclature is given on the pages preceding the text. An unwelcome departure from usual practice is made, however, in the case of the source references, which are given at the foot of the pages and not in a collected list. Also a number of references are made to workers of whom no details are given except the names.

After a most admirable introduction dealing with units and nomenclature, the various modes of heat transfer are surveyed. Much space is devoted to describing rather obvious heat-transfer concepts in rigorous mathematical language, yet the results of the calculations can be very deceptive as shown, for example, by equation 3-49, which is taken to mean that " to double the heat flow, the area of one fin must be increased eightfold," which statement is only true in rather special circumstances.

The first quarter of the text proper constitutes the section on heat conduction, and is newly contributed for this edition. It provides a comprehensive survey of the various cases of transfer by this means, the emphasis being on fundamental laws and mathematical " formulations." Starting from basic theory, the reader is taken through insulation calculations, extended surface arrangements, buried sources and temperature distributions by both flux plot and relaxation methods. Nearly half the section is devoted to unsteady-state conduction problems, cyclic and otherwise, including moving sources and moving interfaces.

As may be expected, nearly half of the book's 500-odd pages are devoted to convection, although remarkably little attention has been given to the problem of designing heat exchangers to transfer a known amount of heat within a given pressure-drop limitation. Fluid flow along surfaces and in channels is taken first, and theoretical expressions developed from this to describe the laminar boundary layer and hence the heat transfer. Frequent appeals to measurement and severe approximations are introduced into the theoretical development, however, and in the end one still has to rely on more-or-less direct experiment to determine practical heat-transfer values. Some recent work on turbulent flow is included and Grimison's classical correlations are given. There is a short account of packed beds and fluidisation. Vortex flow and high velocity effects are covered in detail and results are given of experiments with high-altitude rockets. The present rather inadequate knowledge of flow and transfer effects in rarefied gases is also surveyed in detail. Transpiration and film cooling are well treated and the section ends with accounts of free thermal convection and of condensation and evaporation.

The section on radiation presents an orderly development from basic concepts to practical problems of increasing complexity and also includes an interesting discussion of pyrometry, and a brief survey of solar energy devices. A mere 39 pages, or less than 8 per cent of the book, are devoted to mass transfer. Only the more straightforward cases are covered and the section concentrates almost exclusively on air-water processes. A final brief section is included dealing with practical heat exchangers, particularly the regenerative or " storage " type. There is a 29 page appendix on physical properties which is intended primarily to support the text but it is nevertheless quite extensive and should be very useful also for feasibility or even project studies in many applications.

This important and fundamental book is unfortunately marred by several silly little errors. In Fig. 8-8, for example, there is no label to the " x " scale and Fig. 8-4 cannot be read to the accuracy implied by example 8-2. This curve, incidentally, is one of several that might with advantage have been plotted on a logarithmic grid. It is also one of several that might with advantage have had more care taken in joining up the French curves. It is surely inexscusable to give pressures as so many " atm/in^2." Then there is the list of references for material properties, many of which have no indication as to what materials are dealt with by which reference!

There are 35 examples in the text, illustrating particular points of interest, and a total of 105 problems following the various chapters. Many of these cannot be solved, and the author explains that this is to illustrate what may be expected in engineering practice. His goal of providing an introduction to heat and mass transfer has been well reached, however, and this book should take its place as a standard work on the subject.

OWEN W. DUMPLETON

Dynamic Affluence

Man the Maker. By R. J. FORBES. *Constable.* (30*s*)

A Changing America—at Work and Play. By A. W. ZELOMEK. *John Wiley, New York; Chapman and Hall, London.* (32*s*)

One test of a man's attitude to his fellow men is his response to the technological revolution of our age. A contempt for the material advance that it has brought to the masses betrays an ignorance or lack of concern for the way millions of people lived in the past and still live to-day. A dislike of this attitude is one of the things which make Sir Charles Snow such a refreshing writer on scientific topics. In his Rede lecture at Cambridge he pointed out the appalling ignorance, among educated people in this country, of the facts of industry which have shaped the modern world.

Unfortunately, although there are many economic histories, there are few written by authors with more than a passing acquaintance with science or engineering. There are few complete histories of technology itself, although the gap has now been lavishly filled by the Oxford History. But this work is much too expensive and lengthy for the average reader and Dr. Forbes' book, first published in 1951 and now reprinted, is an excellent introduction to the subject.

He confines himself to the essentials of his story, dealing mainly with power resources, transport and communication, metallurgy, glass, chemical technology and some aspects of civil engineering. His purpose is to show the part technological invention has played in man's social and political development. He draws attention, for instance, to the influence of irrigation schemes on the formation of nations with central power in the ancient world; to the effect of development of roads and weapons on political and military power and, of course, to the successive developments of wind, water, steam and electric power on standards of living and the growth of towns.

For engineers it is interesting to read that Dr.

Forbes believes the smith to have been the earliest professional craftsman, spending his whole day at his specialised work. From him came a long line of miners, metallurgists and metal-workers.

The growth of the influence of science on engineering after the eighteenth century is rather sketchily traced. Modern writers are tending to attribute rather more part to the scientist in the industrial revolution, and it is also the case that the eighteenth century scientists found many fields for study in the machines of the craftsmen. It is surprising to read that the social sciences were the " chief glory " of the eighteenth century even if the term is restricted to political economy. For a book which emphasises the interaction between technology and society it is an omission that, in describing the enormous growth in the sums spent on research in the United States, no mention is made of the fact that a large proportion of it is for defence. The text contains a number of misprints. But in spite of minor criticisms, the book will interest lay and technical reader alike and contains a useful bibliography as a spur to further reading.

Dr. Zelomek, who is a business consultant and part-time professor, has no doubts of the benefits of engineering in his own country. His book might be described as " sociology without tears," but its facts are genuine and relevant for anyone wishing to understand the effects of technical change on the American way of life. It covers such varied fields as the changing position of women, automation, leisure, culture and the growth of the service industries which are becoming the true measure of the individual American's standard of living. How many people know that, of those not on farms, two-thirds of Americans are employed in service industries, including wholesale and retail trade and government? The author is a liberal minded man and, although in a sense his book is a defence of the affluent society, he is not uncritical of its current scale of values.

AUSTEN ALBU

Strength at High Temperatures

The Nimonic Alloys. By W. BETTERIDGE. *Edward Arnold.* (80*s*)

The development of the jet engine and the missile has called for a great effort on the part of the metallurgist to produce alloys of high strength at elevated temperatures, coupled with good oxidation resistance. In this field the Mond Nickel Company have played a prominent part.

The great experience of this organisation in the development of electrical heating elements provided a good starting point for the series of alloys now known internationally as the Nimonics. These alloys, while retaining the basic elements (nickel and chromium) of the heating-element materials, have had to be developed by the addition of other elements to confer greater strength and structural stability at temperatures up to 1,000° C and above. This has of necessity required intensive metallurgical research to produce the alloys and to translate that research into the practical use of the alloys, that is, the production of sound ingots, forming into bars, sheets, wires, and the making of cast shapes.

The fascinating story of the Nimonics might have been pieced together by the engineer or metallurgist by collecting together all the data sheets, technical reports, contributions to symposia and metallurgical conference reports, which have been published on these alloys over the last few years. However, the most efficient abstracting system could never have achieved what Dr. Betteridge has done so efficiently and readably in his book *The Nimonic Alloys*.

Dr. Betteridge, a member of the Mond Nickel Company research team, has had a unique opportunity of familiarising himself with all aspects of the subject, since he was for many years engaged in the development of some of the more advanced alloys of the Nimonic group.

One of the difficulties of producing a book on such a subject is to decide whether the time is right. The speed of development of new alloys is such that any book on high-temperature materials is likely to be out of date by the time it appears in print. This criticism might be levelled at *The Nimonic Alloys*; this, however, would be quite unjustified. While it is true that some of the later alloys are not discussed, the book covers in some detail the basic principles of alloy development including phase diagrams of the more important alloy systems. Moreover, there is full discussion of the mechanism of precipitation hardening, and the part that various elements play in developing the strength and structural stability at elevated temperatures. In addition, the relationship between heat-treatment condition and microstructure is well covered.

There is, therefore, a great wealth of basic information which not only helps the reader to understand more clearly the alloys in current use, but prepares the ground for the newer alloys which are in many cases the logical metallurgical successors of those which have gone before.

Because of the wide range of subjects embraced, and the nice balance maintained between theory and practice, *The Nimonic Alloys* should appeal to both the student and the practising metallurgist or engineer. Those who face the problems of high-temperature materials for the first time will find this book a valuable introduction to this important series of nickel-base alloys. Those who have long wrestled with the problem will welcome it as a reference book, and delight in the at least temporary respite from information hunting in one field of high-temperature metallurgy.

The book contains 332 pages, in which there are 111 tables and 124 graphs covering phase diagrams, solubility curves, hardness curves, mechanical properties of wrought and cast alloys as well as electrical and physical properties. There are also many photographs and photomicrographs. Chapters treating methods of chemical analysis and identification are included, machinability, formability, welding and brazing are well covered, while corrosion, oxidation and sulphur attack are not forgotten. In fact, it would be difficult to think of an aspect of the subject which has not been dealt with in greater or lesser degree.

The book is set out in a logical and readable manner, is well indexed, and graphs and tables are in close proximity to the related text. There is also a good bibliography of 144 references covering all specialist requirements in this field.

Altogether this is a first-rate book which should find a place on the bookshelf of all those engaged in the metallurgical and engineering aspects of high-temperature materials. There is no doubt that *The Nimonic Alloys* will be much used as a book of reference for many years to come.

E. R. GADD

Action and Reaction

Electricity and Magnetism for Engineering Students. By A. W. HIRST. *Blackie and Sons.* (40*s*)

The official adoption of the MKS System of Units by the electrical engineering fraternity (as embodied in the Institution of Electrical Engineers) must be, by now, almost complete in the field of education. How much time will elapse before we lose the diehard core of reactionary c.g.s. system users may be partly influenced by the quality of available textbooks. Some books there are which were written in the logical MKS manner (which is much more elegant than the c.g.s. manner) while others have been recast into an MKS mould, though seldom with complete success. Of those dealing with the fundamentals of the subject, A. W. Hirst's *Electricity and Magnetism for Engineering Students* is outstanding for clarity of exposition, readability, and the excellent typography which is a hall-mark of the publisher, Blackie. Having used the original (c.g.s.) edition as a textbook for his own matriculation and intermediate work, and later as a basis for teaching GCE and ONC classes, the reviewer offers a criticism sharpened by both affection and familiarity.

The third edition of this book, now rewritten in the MKS system, is to be welcomed, for it is still outstanding. The opening chapter treats units and mechanical quantities with an adequacy and concision which make it a useful reference supplement to many a textbook on mechanics. Here are introduced the symbols in conformity with BSS 1991 (which superseded BSS 560 mentioned in the preface) except that for acceleration; " *a* " is listed as the symbol but " *f* " is used in the text.

There follow four chapters describing the electrical nature of matter, simple electrical phenomena, and magnetism, qualitatively. A mathematical treatment begins in the fifth chapter, where there is an obvious reluctance to abandon the obsolete international ampere as a means of defining electric current. This looks like a flaw in the re-casting process, but it is a small one. The rest of the book is notably free from backward looks at the c.g.s. presentation, due to extensive rewriting and rearrangement. Electromagnetism now occupies correctly the key place in the theory originally given to magnetism. In consequence the student is offered in effect a graded presentation in three steps, each of which is logically complete. The first descriptive section is followed by three chapters on the laws of Ohm, Kirchoff, Joule and Faraday, and the thermoelectric effects. The last step begins with electromagnetism and magnetic induction, includes measuring instruments, ferromagnetics; a.c. theory; machines; electrostatics; and ends with thermionics. An appendix contains the c.g.s. theory excised from the original text.

There is much new material—some clearly from another of the author's works. In particular the chapters on a.c. theory and electrical machines have been usefully enlarged, while the added dynamometer theory makes the instrument section more complete. A better treatment of electrostatic theory is now given and the addition of the elements of valve theory is most accept-

Continued on next page

able, though the antique valve symbols are not! Disappointing, too, is the reappearance of the obsolescent theory of electrolysis in which secondary reactions between ions are invoked. Is it not time to introduce Nernst's solution pressure theory at the start and to modernise the teaching of electrochemistry?

A curious omission is of the expression for magnetic (ferric) induction, which has been relegated to the c.g.s. appendix. Even more curious is the avoidance of calculus in deriving simple a.c. theory, although a substantial familiarity with it is required for the Helmholtz equations and much electrostatic theory. There are grounds for complaint also in the electromagnetic theory. Here Ampere's law enters three pages too late, and it is tacitly assumed that the mutual inductance between two inductors is the same when viewed from either. Most authors assume this, though the proof is elementary.

In short, this book, with its many worked examples, numerous problems, and good index is to be recommended to students and opponents of electrical theory in MKS units. One would like to see the blemishes erased in a superlative fourth edition.

K. L. MORPHEW

New Books

Mechanical Design and Analysis. By R. R. SLAYMAKER. *Wiley, New York; Chapman and Hall, London.* (76*s*)

This textbook is made up of a short introductory section on general topics, followed by a lengthy group of "special projects," which are actual case histories of problems and assignments individual American firms had met with.

Fluid Meters, Their Theory and Application: Report of ASME Research Committee on Fluid Meters. 5th edition. *American Society of Mechanical Engineers, 29 West 39th Street, New York 18, NY.* (88·00)

Twenty-one years have elapsed since the last edition of this standard work. The fifth retains the arrangement of the fourth edition but it is a completely new publication, produced in the light of modern developments.

Methods for the Determination of Toxic Substances in Air. *Butterworths Scientific Publications.* (30*s*)

Published for the International Union of Pure and Applied Chemistry, this work takes the form of an introduction dealing with general principles of atmospheric analysis and a number of descriptive papers dealing with individual toxic substances. At present, 21 substances are dealt with. Supplements will be issued from time to time dealing with other substances, and with method amendments; the publication is therefore in the form of a loose-leaf binder, with space for considerable additions.

West of Scotland Iron and Steel Institute Journal, Vol. 65, Session 1957-58. *The Institute, 39 Elmbank Crescent, Glasgow.* (47*s*)

It is often possible to obtain information from the journals of specialised technical societies and institutions which is difficult to find elsewhere, and it is not safe to assume that only those engaged in the trade or profession which the institution serves will find the information of interest. Of five papers in this present volume, one, on metallic recuperators for industrial furnaces, has much of interest to the metallurgist as well as the furnace user, while another, on engineering practice in rolling mills, could be of value to anyone who has to deal with heavy duty bearings, whether or not for rolling mills.

Compression and Transfer Moulding of Plastics. By J. BUTLER. *Iliffe.* (35*s*)

Intended for students of mould design, designers and moulding shop executives. The author has spent over thirty years in this field and claims to have made as many mistakes as anyone in the industry.

Physics as a Career. By NORMAN CLARKE. *Chapman and Hall.* (8*s* 6*d*)

The embryo physicist will find details of education, opportunities and prospects in this guide issued by the Institute of Physics.

Dictionary of Aeronautical Engineering. By J. L. NAYLER. *George Newnes.* (30*s*)

A handy illustrated quick-reference book, giving special emphasis to recent developments in helicopters, missiles, satellites and VTOLs. Incidentally, quite a useful source for abbreviations.

Whitaker's Almanack, 1960. *J. Whitaker and Sons Ltd.* (*Cloth edition:* 21*s*)

Whitaker for 1960 is one of the largest ever published, and a number of new features are introduced. Engineering events of the past year, we are reminded, included the opening of the St. Lawrence Seaway, and the release of details on the Hovercraft and the BMC baby cars.

Modern Physics. By H. A. WILSON. 4th edition. *Blackie.* (40*s*)

A pattern of ten-year re-appraisal appears to have established itself since the first edition in 1928, and the present edition includes new chapters on semiconductors, low temperature physics, and elementary particles.

Scientific Russian. By GEORGE E. CONDOYANNIS. *John Wiley, New York; Chapman and Hall, London.* (28*s*)

Like its two predecessors, dealing with French and German respectively, Professor Condoyannis' new book is intended for the scientist or engineer who needs to acquire rapidly a reading knowledge of Russian adequate to cope with technical articles and books in his field.

Famous British Engineers. By LESLIE HALWARD. 2nd edition. *Phoenix House.* (15*s*)

Intended for young people, this is none the less a readable introduction to the pioneers of engineering for any age. The new edition includes Murdoch, Trevithick and Brunel, and omits Watt and Stephenson, who appeared in the first edition. The others included are Brindley, Smeaton, Telford, Rennie and Nasmyth.

Who's Who in the Motor Industry. 4th edition. *Temple Press.* (42*s*)

Rather wider than the title suggests, and including a directory of the vehicle manufacturing, accessory, and distributing industries, and a list of organisations and associations. The biographical section itself contains some 1,400 names.

Electromagnetism and Relativity: with particular reference to moving media and electromagnetic induction. By E. G. CULLWICK. 2nd edition. *Longmans.* (63*s*)

A book for advanced students and teachers clarifying and integrating aspects of electromagnetism which have received little attention elsewhere. In this new edition several topics have been revised and amended.

Rubber to Metal Bonding. By S. BUCHAN. 2nd edition. *Crosby Lockwood.* (42*s*)

The first edition of this comprehensive survey appeared soon after the Second World War, and the present edition takes account of developments and new information available during the last ten years.

Radioisotopes for Industry. By ROBERT S. ROCHLIN and WARNER W. SCHULTZ. *Reinhold, New York; Chapman and Hall, London.* (38*s*)

A current survey of specific applications aimed at drawing attention to the widespread potential value of radioisotopes in industry for, among others, gauging, radiography, and tracer techniques.

The Directory of Opportunities for Graduates, 1960. *Cornmarket Press.* (8*s* 6*d*)

Presents advertisements of openings for employment with 275 organisations in a convenient pattern, facilitating reference and comparison. A classified index of industries is included.

Impulse-Voltage Testing. By W. G. HAWLEY. *Chapman and Hall.* (32*s*)

Covers impulse generators, measurement and recording, and the applications of this testing procedure which has largely developed during the last thirty years.

Manuel de Base de l'Ingénieur. By S. H. TIDESTRÖM. Tome 1: Mathématiques, Mécanique. *Dunod, Paris.* (5,800 *Frs*)

Translated from the Swedish of *Ingenjörshandboken*, this sets out to provide a handy reference to basic mathematical and physical concepts. Mathematical, mechanical and conversion tables are given.

The Reviewers

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Trade Publications

Copies of any of the following trade publications are obtainable from the addresses given, though distribution is sometimes restricted.

Plant

Furnaces. METALECTRIC FURNACES LTD., Cornwall Road, Smethwick, 40, Staffordshire. Standard box type furnaces are described in a four-page illustrated leaflet.

Slideway Protection. GEORGE ANGUS & CO. LTD., Angus House, 152-158 Westgate Road, Newcastle upon Tyne, 1. Slideway covers in Gatan (an industrial leather) for machine tools. Leaflet.

Tooling Aids. WOODSIDE DIE SINKING CO. LTD., Aire Vale Works, Newlay, Leeds, 13. Specialist tooling aids and standard parts for jigs and fixtures. Complete range in catalogue.

Cold Rolled Sections. WARWICK RIM AND SECTIONING CO., LTD., Golds Green, West Bromwich, Staffordshire. The advantages of cold rolled sections for metal fabrication work in a variety of industries and the production facilities available at the company's plant are described. Sixteen page booklet.

Electrical

Surface Heaters. ISOPAD LTD., Barnet By-Pass, Boreham Wood, Herts. Industrial heaters for vessels from 3 to 3,000 gallons capacity, for pipe lines, valves, etc. Illustrated catalogue PLT.

Miniature Switches. CASTELCO (GREAT BRITAIN) LTD., Castle Works, High Street, Old Woking, Surrey. Miniature precision switches for wall or pendant mounting. Display sheet and catalogue.

Accessories. MK ELECTRIC LTD., Shrubbery Road, Edmonton, London, N9. The 1960 catalogue of switches, sockets, plugs and fittings for all domestic wiring.

Circuit Breakers. ELECTRIC CONSTRUCTION CO. LTD., Fordhouse Road Works, Wolverhampton. Moulded circuit breakers for up to 400A at 600V. Publication MB/NJ-400/3.

Transformers. STANDARD TELEPHONES AND CABLES LTD., Edinburgh Way Harlow, Essex. Open C-core transformers and chokes from 5 to 1,500 VA. Leaflet.

Marketing

Tidying up in the Air Industry

After the massive mergers of late among the aircraft makers comes the purchase by one of the independent air operators, AIRWORK, of the share capital of BRISTOW HELICOPTERS.

This gives Airwork an interest in oil exploration in the Middle East and South America and, more domestically, in commercial flying from the London heliport at Battersea, if and when essential Ministerial permissions can be obtained. The Bristow helicopters are 24 British, French and American models, plus two fixed wing aircraft.

4,000 Edgewise Orders

One of the smallest electrical meters made in Britain was introduced just over a month ago and is already to be used in applications from a Canadian oil refinery to a stereophonic tape recorder.

Made by TAYLOR ELECTRICAL INSTRUMENTS of Slough, a METAL INDUSTRIES GROUP company, the edgewise meter can be used as a voltmeter, a milliammeter, a microammeter and an ohmmeter. Specially designed for crowded control panels, the meter has a frontage of only $2\frac{1}{2}$ in by just over $\frac{1}{2}$ in.

Orders for more than 4,000 of the meters have already come in.

Three Nation Helicopter Struggle

French, British and American helicopter firms are in competition for the provision of high altitude operational helicopters for use by India in the Himalayan mountain border country with China.

The British competitor is WESTLAND putting forward the Wessex and the subsidiary SAUNDERS-ROE P 531. The United States' SIKORSKY AIRCRAFT have demonstrated their S 62, and the French Sud Alouette has also been entered.

The early stage of the eventual order may not be for any large number of helicopters, and it may not only be for one type. But later orders for the Indian Air Force, operating in a country not over provided with airfields, may be in greater numbers.

Another Leyland Price Cut

Few companies can match the regularity of the price reductions announced by LEYLAND MOTORS. Their latest, the eighth in 18 months, is a drop of £50 in the cost to home customers in the group's ALBION MOTORS' Albion Victor VT 15A, a passenger range, and in the Albion Victor VT 19A, a bulk load chassis range. Increasing production of both models has given Leyland's the opportunity to bring the price down. It is being reduced by equivalent amounts for overseas users.

Public transport users in that old British army centre, the Indian city of Bangalore, are now travelling by Leyland. ASHOK LEYLAND, of Madras, built a fleet of Leyland Titan OPD2.9 models for the Mysore government road transport division. They were equipped with semi-automatic Pneumo-Cyclic gearboxes which have no clutch pedal. Drivers for Bangalore were trained in Bombay, which has its own Leyland buses.

Conch International

The advantages of the commercial shipping of liquid methane, in which the British gas industry was in the van with the trial runs of the Methane Pioneer, are likely to be pushed ahead more swiftly by the three company grouping to be named CONCH INTERNATIONAL METHANE LIMITED.

The new jointly owned company has been formed by the ROYAL DUTCH-SHELL GROUP, CONTINENTAL OIL, and the UNION STOCKYARDS AND TRANSIT COMPANY of Chicago.

Continental Oil and Union Stockyards were early workers on research in liquefied natural gas, acting through a joint subsidiary, CONSTOCK INTERNATIONAL METHANE. Constock have spent a lot of money to gain knowledge and patents in transporting liquid methane at -258° F.

The first liquid methane cargo was carried by the Methane Pioneer for Constock and the BRITISH GAS COUNCIL from Lake Charles, Louisiana, to the Thames in February last year. The Methane Pioneer, jointly owned by the Gas Council and Constock, has continued carrying its 2,000 tons of liquid methane to the NORTH THAMES GAS BOARD's depot at Canvey Island ever since, despite occasional asides from the miners and others.

The new subsidiary brings together the experience of Constock and the world wide distribution facilities of Royal Dutch-Shell. It opens up the prospect of liquid methane being carried to much more remote spots than Thames Haven.

Commonwealth Turbo-Generators

One of the largest turbo-generators in the Commonwealth, a 200 MW PARSONS product is now in service at the Richard L. Hearn generating station, Toronto. The machine is the first of four ordered by the ONTARIO HYDRO ELECTRIC POWER COMMISSION for the Hearn station. The total capacity of the station, when these four machines are installed, will be 1,200 MW. It will then be the largest in the world equipped with machines by a single manufacturer.

For their Lakeview power station near Toronto the Ontario Hydro Commission have ordered, again from Parsons, turbo-generators of 300 MW.

Fairey Deliver to Indonesia

Two Fairey Gannet anti-submarine aircraft have been handed over to a representative of the Indonesian Government. They were the first of 18 which FAIREY AVIATION are making for Indonesia. Six more will be delivered before the end of the year and the rest in 1961.

The two aircraft were handed over at a ceremony at Fairey airfield in White Waltham, Berkshire, watched by some of the Indonesian pilots Fairey have been training.

The 18 aircraft are all former Royal Navy machines. They have now been fitted with Bristol Siddeley Double Mamba turbo-prop engines.

Pye Closed Circuit at Ten Pins

Equal to the gloom of those who foresee television ownership levelling off and production of sets falling, is the ingenuity with which new uses for television are found.

The Ten Pin Lanes bowling centre opened in North London last week might be thought to be all brawn-and-muscle control. In fact automatic devices return the bowls, and the equipment includes closed circuit television.

The promoters of this American version of the English skittle game want the wives to come along as well. And that means something must be done about the children for whom a baby sitter would be expensive or hard to find. So, PYE have fitted a television circuit which throws on to two 21 in screens near the bowling area pictures of a children's nursery built into Ten Pins.

The 625-line equipment includes remote controlled lens change, focus, pan and tilt. If the control manager at the monitor screen wants to throw a close up of somebody's baby on the screen he has only to operate the switches.

A 21 in close up of Junior having his ear twisted may be a fitting accompaniment to the thunder of the bowls.

Making the DH121 and VC10

The work of producing AIRCO's DH 121 is going ahead. The latest announcement is that Sperry's Vickers hydraulic pumps are to be fitted. An order for 72 Type PV 3915 variable delivery pumps plus ancillary equipment has been placed. Similar equipment was recently ordered for VICKERS-ARMSTRONGS (Aircraft) VC 10 long range airliner.

A potent factor in favour of the Vickers pumps is that they already are approved as airworthy. Designed by VICKERS of Detroit, USA, the hydraulic units are made by Sperry in Britain under licence.

Anglo-Hungarian Trade Agreement

The recent British trade agreement with Hungary is a small pointer to better British trading with East European states. The British import, £4·5 million, will be mainly in agricultural products but with some chemicals and aluminium. The Hungarian imports will be of machinery, textiles, vehicles, chemicals and radio television and telecommunications equipment.

Machine-Maiden Agreement

The threading equipment makers, LANDIS MACHINE-MAIDEN, have appointed ALFRED HERBERT sole agents of that part of Landis machinery output fitted with Landis tangential threading equipment.

The sole agency agreement does not apply to Landis A and ST radial diehead machines or barchamfering and tagging machines, which will continue to be distributed through trade channels.

Engines for Portugal

BURMEISTER AND WAIN, of Copenhagen, Denmark, have set up a new company in Portugal to make B and W engines for both Portugal and Angola. When the factory has been built production will at first be of small marine engines. Most of them will be from 200 to 400 b.h.p. for use in coasters, fishing boats and other such craft. In the second stage of the factory development B and W plan their own foundry.

Of the seven nations of the European Free Trade Area, Portugal has the farthest to go in becoming industrialised. Lacking capital of her own, the most remote of The Seven will develop with greater speed if other companies follow the lead of B and W.

Exporting to 71 Countries

The rise in value of British exports last year to 5 per cent was slightly ahead of the rise in the volume of those exports—4 per cent.

A particularly lively engineering firm who have this ratio the other way about are SIMMS MOTOR UNITS, of North London. The value of Simms direct exports last year rose above their record 1958 figure by 33 per cent. And because of price reductions the volume of exports from the firm was up by 35 per cent. Simms were last year exporting to 71 countries.

More Elliott Expansion

A change of name and the acquisition of another company in the nucleonic instrument field springs from a new move in which ELLIOTT-AUTOMATION Limited are concerned.

Elliott have bought ISOTOPE DEVELOPMENTS (BEENHAM) Limited, a subsidiary of ISOTOPE DEVELOPMENTS Limited. The stated purpose of this is to "avoid duplication of scientific effort in the nucleonic instrument industry." If agreement is given at a special meeting being held today, Isotope Developments will change its name to NUCLEONIC INVESTMENTS Limited and will continue to own the radiation measuring instrument company R. A. STEPHEN and Company.

Automatic Canteen and Camp Bird

American interest in Britain as a promising market and as a door to others has now extended to automatic selling.

CAMP BIRD and the United States AUTOMATIC CANTEEN company have set up a new company in this country to be named ROWE AUTOMATIC MERCHANDISING. The president of the American company and the chairman, Mr. John Dalgleish, of the English group, are among the directors of Rowe Automatic.

Each company has a half share in the new venture, whose issued capital is £204,544. It is intended that Rowe Automatic shall market and operate automatic selling machines on its own behalf.

Oil Switches with Manual Spring Operation

Johnson and Phillips Limited, Charlton, London, SE7, have recently introduced two oil switches for systems up to 250 MVA at 6·6 kV and 350 MVA at 11 kV. They are type SX/A, which is air-insulated and type SX/F, which is compound filled. Both have been well tested at the Keuring van Electrotechnische Materialen Laboratories, Arnhem (KEMA). They are intended to line up with circuit-breaker units in composite switchboards, for switching a ring main or spur feeder cable, or to provide a safe means of isolating the earthing sections of cable and connected apparatus (such as transformers or switchgear) for maintenance purposes. They have been designed for a normal rating of 400 A and fully tested to B.S. 2631 for load breaking at 120 A and 520 A and for fault making on to the main and integral earth contacts. Certificates have been obtained at the KEMA laboratories for system fault capacities of 250 MVA at 6·6 kV, 250 MVA at 11 kV and 350 MVA at 11 kV.

The units are of extremely robust and compact construction. They are exactly the same width of 1 ft 9½ in as the breaker units and thus permit the substitution of a circuit-breaker unit for an oil switch without serious disturbance to the switchboard layout, should operating conditions change.

A special feature of the type SX oil switches is the manual spring-operated mechanism, which removes the dangers of hesitancy on the part of the operator when closing the switch, by automatically taking the operation out of his hands. The switch has a separate system of blades for main and earth connections. They are of the signal arm type and both main and earth blades are hinged on to a common cable box terminal. The individual blades are operated by separate shafts and insulating links, but a single common spring is employed for the rotation of either shaft. This spring is provided with a " core " of tubes which joins the external levers of the main and earth switches and is so arranged that a foolproof interlock permits both main and earth blades of the switch to be open together, but only one to be closed at a time, as shown in Figs. 1 to 4.

To open and close the switch the spring is charged by means of a removable handle, which the operator places over the top spigot and

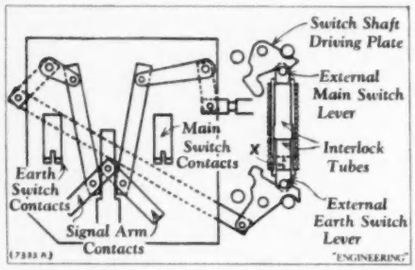


Fig. 1 Switch with both earth and main switch blades open. Note the space " X " between the two parts of the spring core. This allows either earth or main switch to be closed on to its contacts, but does not permit both to be closed at the same time.

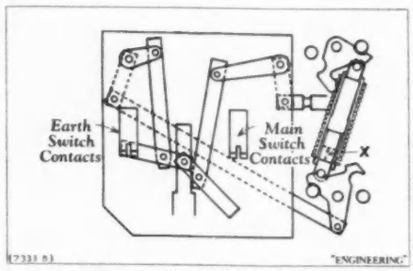


Fig. 2 Earth switch closed. Note the space " X " between the two parts of the spring core.

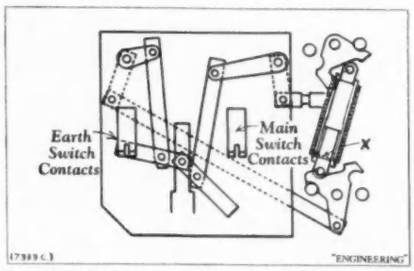


Fig. 3 With earth switch closed, an attempt has been made to close the main switch. The core ends have butted together and space " X " has disappeared, thus preventing further movement of the main switch.

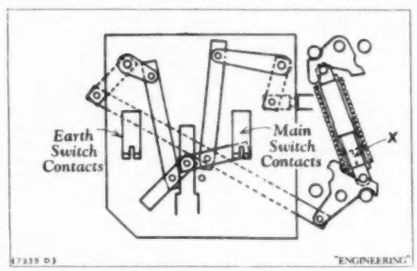


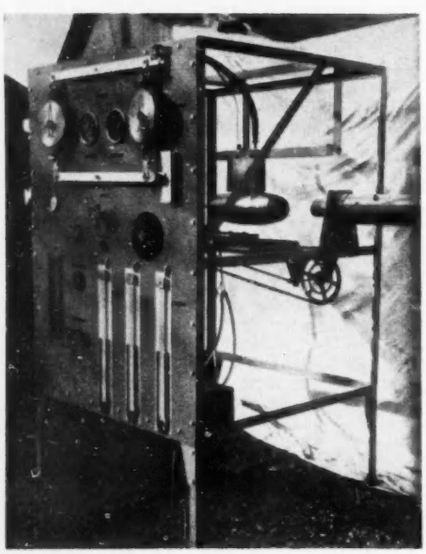
Fig. 4 Main switch closed. The space " X " is again open.

associated lever pin and turns through approximately 45°. The lever pin passes over-centre, and then, driven by the spring, picks up the switch shaft driving plate and rotates it smartly; thus closing (or opening) the switch. The mechanism is designed to give a suitable operating force to the switch actuating shaft, regardless of the speed at which the operator charges the spring. After initial compression, the spring takes the action of the switch completely out of the operator's hands. The opening or closing of the earth blades is carried out in a similar way by applying the operating handle to the bottom spigot and lever pin.

CABLE TESTING

Means are provided for inserting cable testing plugs through the top cover of the unit, but access to the test orifices can only be made with the earth blades closed. This means that the main blades of the oil switch must be open. With the earth blades closed, it is safe to connect cable test voltage leads to the test plugs and to open the earth just before applying the test voltage. Opening the earth blades automatically traps the test plugs, which cannot then be withdrawn from the test orifices until the earth blades of the oil switch are returned to the closed position.

Subsonic Ramjet for Demonstrating Heat Engines



The subsonic ramjet, mounted in an air stream on a static test stand, is a very useful item of demonstration equipment for training aeronautical engineers or, in fact, anyone interested in heat engines. P. A. Hilton and Company, Radlett, Hertfordshire, have recently started producing complete equipment for this purpose and have already installed the first set in the Aeronautics Laboratory of Imperial College.

A specially developed low speed ramjet engine is used which burns propane gas and operates at air speeds below 300 ft per sec. An air supply compressor, requiring a motor of only 8 h.p., brings this equipment well within the scope of normal engineering laboratories. The engine (5 in diameter and 15 in long) is mounted on an hydraulically damped thrust measurement linkage in the test stand, which carries all the necessary controls and instruments for the student to carry out a complete performance study.

The basic principles common to all heat engines can be demonstrated, such as the compression of air or gas, the addition of heat through combustion, and the subsequent work done by an expansion process.

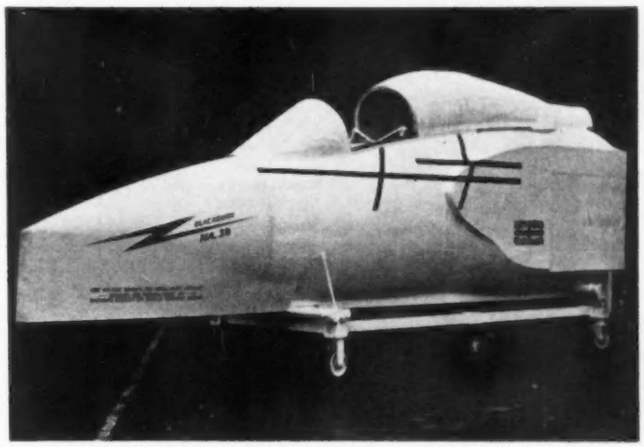
The ramjet has no mechanical moving parts and this, together with the internal design of this particular engine, enables a water-cooled pilot static pressure probe to be passed right through the engine without obstruction. A complete picture of the pressure variations taking place throughout the operating cycle can therefore be obtained.

No lubrication system is necessary, because there are no moving parts and a propane fuel system, operated by its own vapour pressure, makes the whole equipment simplicity itself. It is cheap to install and operate and requires no skilled maintenance. Ignition is by a special sparking plug and trembler coil, powered by a small dry battery. The equipment is so designed that the various components may be tested separately. The air and fuel systems can be used for work on other test rigs.

The engine is not a scale model; it has been specially developed from a unit used for experimental work on helicopter rotor tip propulsion. The test stand, based on the requirements of an actual engine test bed, has been specifically designed for educational work.

The subsonic ramjet has as yet few actual applications and because of this has not received the attention it deserves. No other air consuming engine, however, is as simple in construction and principle or so easy for the student to understand and examine.

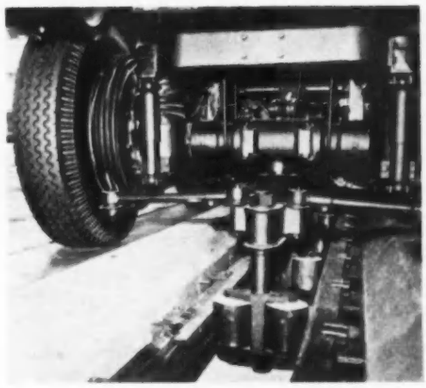
(*Left*) *RAF Gloster "Javelin" flying over safety barrier devised to prevent runway overshooting.*



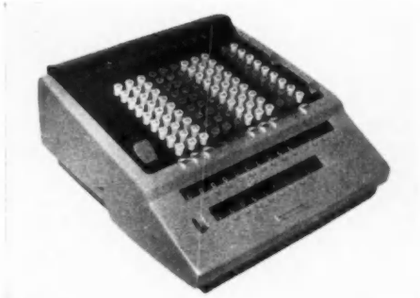
(*Above*) *Rocket-propelled sled used for high speed seat ejection tests of the Blackburn NA-39 in California.*

Meter designed by Smiths to show a subscriber how much a trunk call is costing while he talks.

The handset of the Centenary Neophone, made by AEI Telecommunications Division, weighs only 7 oz.

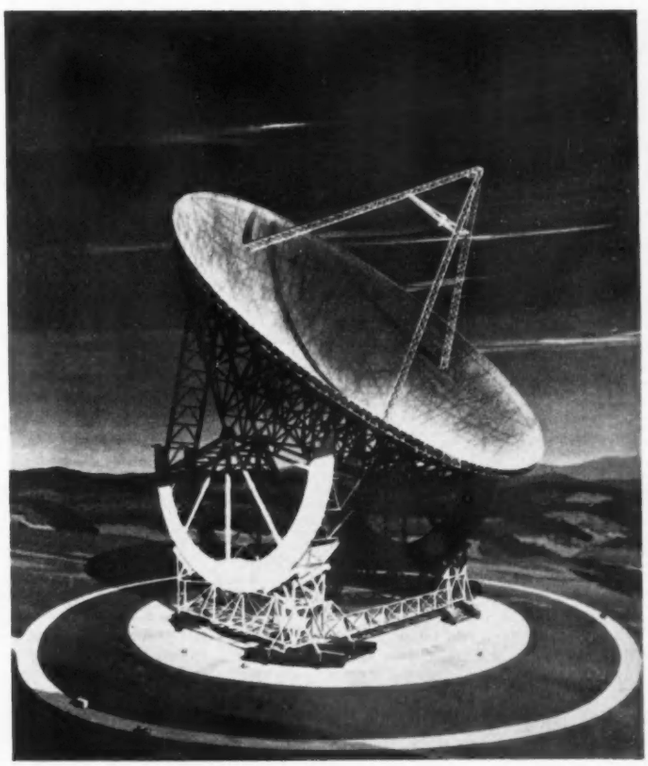


Pneumatic tyres on bogie assembly of suggested coach for the Milan underground.



(*Left*) *Sumlomatic semi-automatic multiplication and calculating machine (Bell Punch Company).*

(*Left*) *The first escalators fitted to a British passenger vessel, installed by J. and E. Hall Limited in the Royal Mail Lines Amazon.*



(*Right*) *The world's largest movable radio-telescope now being erected in West Virginia for the US Navy.*

Magnesium Track Links for Tractors

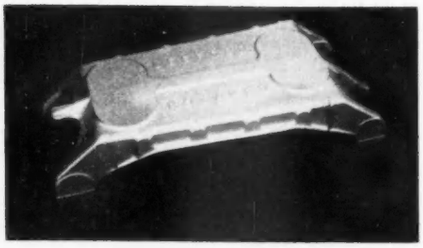
The Rotaped half-track conversion unit for farm tractors is an example of the use of magnesium for agricultural machinery. The unit consists basically of a pair of special wheels, each rolling inside a system of six linked track sections, which take the place of the normal tractor wheels. As the wheels turn, they lay the articulated sections before them, like a crawler tractor, to form a continuous track. The Rotaped gives an ordinary tractor the advantages of a crawler when necessary, but at a much lower cost and without impairing its use for normal operations.

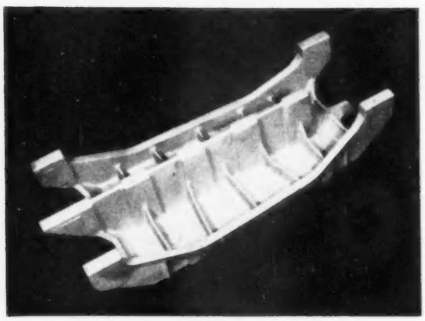
Leeford (London) Limited, London, W1, have been making these conversion units for some years, but the latest models now use magnesium track links, which cut the weight of the unit down by half, thereby increasing the operating speed and making them easier to handle and fit. Incidentally, the changeover from pneumatics to Rotapeds takes no more than 30 min.

The track links are manufactured as gravity die castings by Sterling Metals Limited, Nuneaton, from magnesium C alloy, a general purpose alloy, and the castings are solution heat treated before machining.

Two models of the unit are now being manufactured, one for tractors in the 25 to 30 h.p. range and the other for tractors of around 40 h.p. Adaptor plates allow the Rotaped to be fitted to most of the popular tractors now on the market. The latest models, equipped with magnesium alloy track, will increase the drawbar pull of a tractor by over 100 per cent, according to the makers. The low weight of the new models, combined with the large contact area, reduces the pressure on the ground by 85 per cent and prevents the tractor from compacting the soil after cultivation, and the substantial reduction in wheel slip is claimed to reduce fuel consumption by as much as 30 per cent.

The track loading is considered as the weight of the tractor, plus equipment of approximately 1 ton, which moves on the track links in a longitudinal direction. In addition to this vertical load, there is a horizontal load from the tractive effort of the tractor which has a maximum value of 2½ tons. Both loads are for a single track. When the Rotaped is in the square position, the chain arrangement, which controls the movement of the track links, causes two track links to bridge the concave contour of the ground. In this case, the vertical load is applied where two track links are joined. This is theoretically the largest vertical load applied. In practice, however, track laying equipment works in soil containing stones. It is unavoidable that foreign matter should enter the tracks, and provision has to be made to prevent overloading of the track members. This paticular problem has been solved by having the chain sprockets cushioned by rubber rings which limit the maximum loading on the links joined to about 2½ tons.





(Left) Farm tractor fitted with the Rotaped conversion units.

(Right) Details of the magnesium track links.

Computer for Engineering Calculations

Designed to fill the gap between the desk computer and the really large computer, the Royal McBee Corporation of 36 Worship Street, London, EC2, have introduced their LGP-30. The machine is simple to programme, for it has only 16 code letters of command.

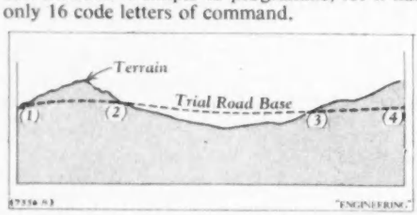


Fig. 1 The terrain and the first trial road base.

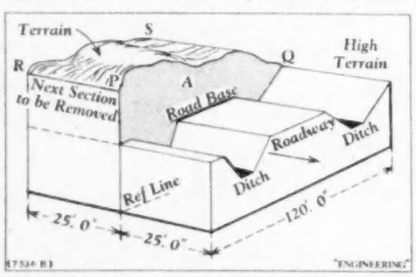


Fig. 2 Cross-section showing the work to be done.

Assume that it is desired to build a single lane highway between points (1) and (4) in Fig. 1. The dotted line shows the first trial position of the road base, from which it can be seen that earth must be moved from section 1-2 and 3-4 and fill added to section 2-3. The main problem in the construction is to determine a location for the road base so that the overall cost of construction is a minimum, always assuming that the spoil is suitable as fill.

There are two fundamental costs in the construction:

(*a*) The cost of materials used for the road surface, and

(*b*) The cost of earth movement.

The first cost is relatively easy to estimate. Once the road base is located, the length, width and depth of the road surface are known, and the volume of material to be used can be calculated. However, the determination of the volumes of earth to be shifted is more tedious and this is where a computer finds useful application.

A section of the highway is shown in Fig. 2. The cross-sectional area A of the earth to be moved is further complicated by the two roadside ditches. The volume of earth in the next section now has to be calculated. The surveyor maps the coordinates of the terrain at 25 ft intervals. For the section in Fig. 2 he would map perhaps 20 points along the curve PQ and a similar number on the curve RS. The area between PQ and a reference datum (say, sea level) is first found. Subtracted from this is the area between the line of the road base and the same reference line. This gives the area of correction A. The volume of earth in the next section to be cut away is then the mean of the areas of cross-section at PQ and RS multiplied by the distance (25 ft) between. Although the mathematics is simple enough, a lot of calculation is necessary to find this one volume, and for each mile it is estimated that 31,630 such calculations are necessary.

Following the procedure for every 25 ft section along the highway gives the total volume of earth to be excavated or to be filled in. If these volumes are equal to one another, subject to any other over-riding considerations, the original choice of road base was a good one. If not, it means that another base must be chosen and the calculations carried out once more. Because of the labour involved a construction company, would not be anxious to go through the calculations more than twice. Using the computer however, the volume calculations are routine, the mapping points being fed into the computer and the volumes of earth for every section printed out. This means that many alternative designs can be considered and the chances of a better location of the road base increased. In addition, since the engineer does not have to do this donkey work, he can spend his time more profitably on design. With this computer it is claimed that up to eight miles a day can be investigated.

Measuring Dynamic Loads on Gear Teeth

Accurate determination of the dynamic loading of gear teeth is important to both designer and manufacturer. A convenient technique for achieving this has been developed.

By H. Kohler, Ph.D., G.I.Mech.E.

D. Napier and Son Limited

The loads on gear teeth can only be calculated with reasonable accuracy when the speed is low. At higher speeds an additional load component appears, and it has been found that this varies irregularly with speed and can reach a value several times greater than that of the directly-calculated load. This additional load is generally referred to by gear designers as the dynamic increment load. The accurate calculation of this dynamic loading is of the greatest interest both to designers and to manufacturers of gears. Unfortunately, as all gear designers know, while there are many methods (of varying degrees of complexity) for doing this, the results of the calculations are of doubtful validity. Some work to measure experimentally spur gear dynamic loads, and to correlate the results with a theoretical investigation, was recently carried out at Sheffield University by the author, under the supervision of Professor W. A. Tuplin, and with the support of D. Napier and Son Limited.

Gears were run under known conditions, and measurements made of the gear errors, and of the actual dynamic loads on the teeth during tooth action. A correlation of the results was found to be possible. As a part of the work a technique was established for tooth load measurements. It is felt that this may be of general interest and although other experimental methods are reported (notably in references 2, 3, 4 and 5), the present technique is thought to be more convenient.

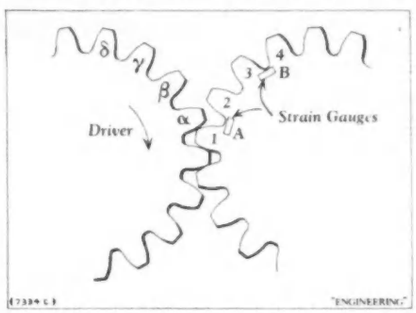


Fig. 1 (left) Barium titanate strain gauges were attached to the side of the gear, in the positions shown.

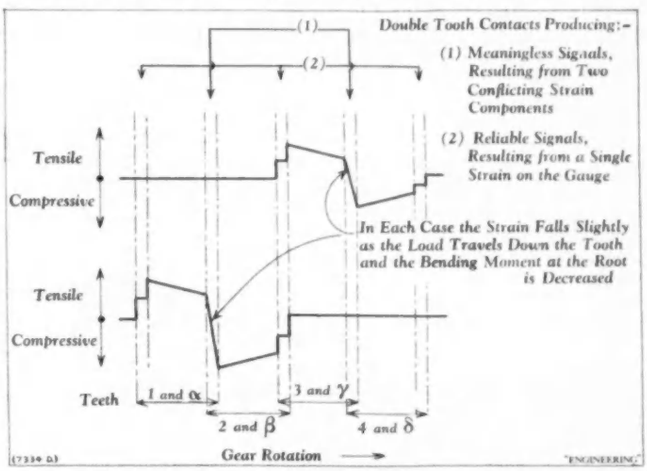


Fig. 2 (right) This graph shows "ideal" signals, such as would be obtained if there were constant toothload during single tooth contact.

METHOD

Basically, the method is simple. Teeth on which measurements are to be made have strain gauges attached to their sides, and the signals from these gauges are recorded during running. As the gauges have to be used at positions of relatively low strain, the selection of a suitable type is important. Wire gauges, though having the advantage that static calibration would be possible, would have required quite elaborate instrumentation, and, in particular, some slip-ring difficulties might be expected. Crystal gauges were therefore chosen, as they give signals several orders of magnitude greater.

The crystals used were of barium titanate, although lead zirconate might also be used, and would be preferred in many applications. They were attached to a side of the gear in the position shown in Fig. 1. Those used were $\frac{1}{16}$ in $\times \frac{1}{2}$ in and 0·030 in thick, but they may be used in sizes from $\frac{1}{16}$ in square and $\frac{1}{100}$ in thick upwards. Since these are necessarily large with respect to the teeth, they cover regions in which there can be considerable stress gradients. Consequently the signals cannot be interpreted directly as strains at the measuring point. However, the signal magnitude is an indication of the total strain under a gauge. For any one point of load application, the total strain at the gauge is proportional to load. Hence, the signal amplitude is also proportional to load. Thus, if for a given gauge the signal for a given load is known, the load corresponding to a signal of different amplitude follows by simple proportion.

The gauges are robust and easy to attach. They produce a voltage signal proportional to the total strain at the face of the gauge. These signals are large for strains of the magnitude encountered in measurements on gear teeth. As a result they could be taken out through simple mercury slip-rings to a double-channel oscillograph using a gain of only 30 for each channel. A single sweep recording technique was used, the oscillograph screen being photographed eight times per second on 16 mm cine film. It was found that a semi-continuous record of this form was essential. The load on a gear tooth is critically dependent on speed and, for general work, where a survey of load variation with speed is the object, fairly complete recording over the entire speed range is needed.

It is well known that crystal gauges can only be used for dynamic measurement; they give a voltage signal which could only be maintained under steady stress if they had infinite resistance. In practice, of course, both the crystal gauge and the associated measuring equipment have finite impedances. With the arrangement used, dynamic signals below about 100 c/s were not satisfactorily reproduced. As dynamic calibration is possible, this is no restriction on their use in this application.

Crystal gauges are to some extent restricted in use by temperature. The barium titanate gauges used cannot be exposed safely to temperatures above about 90° C. Lead zirconate may be used up to about 280° C.

TYPE OF RECORD

Fig. 1 shows the beginning of the series of tooth engagements in the region to which the gauges are applied. The signals which result when the gears rotate are described in the following manner: Under the conditions shown, gauge A will indicate a tensile strain when tooth α engages with tooth 1, and a compressive strain when β engages with 2. Gauge B will give similar signals for the engagement of γ with 3 and δ with 4. So, with the two gauges used, there is a continuous record of the total tooth load over four successive tooth engagements. The idealised signals which result for a constant load with no dynamic increment are shown on Fig. 2. With the proviso that the teeth are nowhere strained beyond the elastic limit, this signal magnitude will vary in proportion to the applied load.

ESTIMATION OF TOOTH LOADS

A calibration for the gauge signals is necessary. This is obtained by running the gears at known load and at a speed fast enough for the signal to have frequencies sufficiently high for the equipment to record satisfactorily, but slow enough to enable the part of the signal due to static load to be clearly seen. In this case, 1,000 r.p.m. (about 200 tooth contacts per second) proved suitable. Here the transmitted load was still almost uniform, and the dynamic component small and easily recognisable. At the beginning and end of each tooth engagement there is, of course, a period of double tooth contact as the next pair of teeth comes into mesh.

These double contacts produce two types of signal, as shown in Fig. 2, according to whether the gauge is subject to two opposing strain components or not. Thus, for instance, at the end of the engagement of tooth pair 1 and α there is contact also between teeth 2 and β. Gauge A is subject to tensile strain from the former and compressive from the latter, and the resulting signal is meaningless. At the end of the next engagement, however, when there is double contact between 2 and β and 3 and γ, gauge A is subject to compressive strain for the first contact and gauge B to tensile strain from the second, so that the signal from each is proportional to the appropriate tooth load during this double contact, and a complete picture of load transfer is obtained. The existence of some meaningless double-contact signals offers no serious difficulty, particularly with gears of low contact ratio, where the periods of double contact are very short.

Since the gauges project below the tooth roots they also respond to strains transmitted round the gear rim. This is sometimes an advantage, as each gauge produces a signal which varies proportionately with the load, even when the loaded tooth is some distance away. In such cases, of course, the signal amplitude is much reduced and the signal-to-load relationship of the calibration no longer applies. Thus, if high tooth loads should occur in the periods of uncertainty during double tooth contact, these would appear in the signal from another gauge.

Continued on next page

No serious loads, therefore, are likely to be overlooked.

ACTUAL RECORDS

Fig. 3 shows a typical set of results taken by this method. In comparing these with the idealised signals of Fig. 2 it must be observed that the upper traces are reversed in sign, so that on the upper trace tensile strain is indicated by downward-going diagrams, and on the lower trace by upward-going ones. Analysis of such records, simply by use of the calibration of signal amplitude against tooth load, gives values of the tooth load during an engagement. A large number of records yields, on analysis, a set of data of loads and corresponding speeds. To illustrate the form of this data, Fig. 4 shows the maximum load experienced by a particular tooth pair as a function of running speed, for a certain applied load. The gear error needs to be known to interpret this result, and is given in Kohler.[1] Here, the results are shown only to indicate the type of information that the experimental method described gives. In fact, not only peak loads but a fairly complete picture of the variation of load with the phase of contact is obtained directly, and the presence of resonances in the gear system which affect tooth loads can be seen, and their frequencies determined.

This technique offers a reasonably simple method of measuring actual tooth loads. It is clearly useful wherever it is important to know exactly how a gear pair is behaving. In particular, it seems well-suited to the experimental finding of optimum tip and root reliefs.

REFERENCES

[1] H. Kohler. "Mechanism and Measurement of Dynamic Loading in Spur Gears," Thesis, University of Sheffield. (The work described was carried out at the Post Graduate Department of Applied Mechanics, University of Sheffield, supervised by Prof. W. A. Tuplin.)

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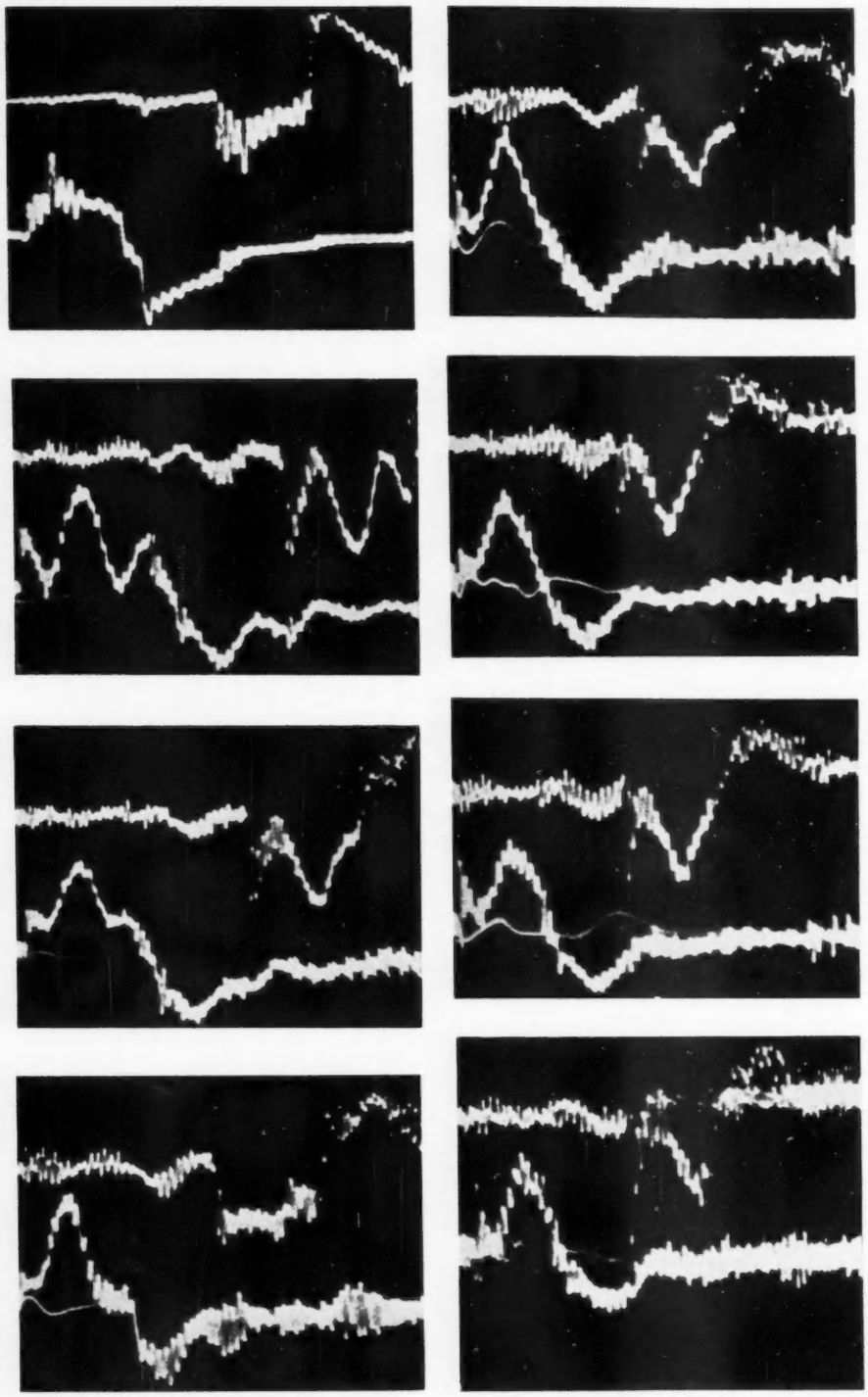
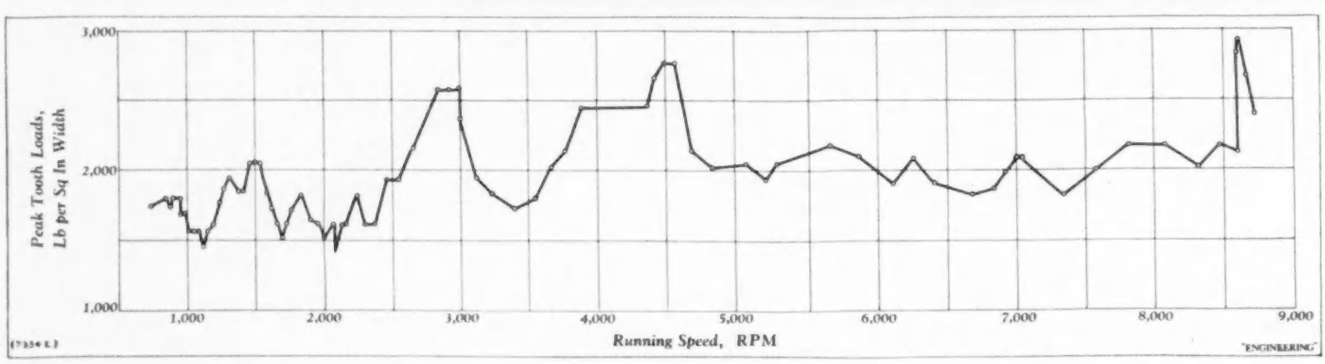


Fig. 3 (right) These are typical strain gauge measurements. In comparing them with "ideal" signals it must be remembered that the upper traces are reversed in sign.

The Test Gears	Strain gauge measurement at r.p.m.	
Straight spur gears	Left hand col.	Right hand col.
Ratio 1 : 1	1,000	7,080
14 teeth	5,170	7,900
3 D.P.	5,870	8,500
Meshing circle diameter, 5 in	6,720	8,620
Face width $\frac{5}{8}$ in		
No tip or root relief		

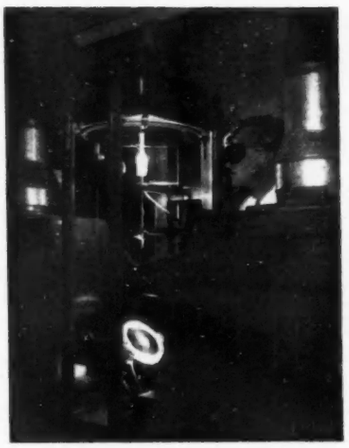
Fig. 4 (below) Variations of the maximum total tooth load against gear speed for tooth pair 3 and 7; applied load is 1,000 lb per in.



Refractory Crystals of High Purity

Chemical engineers at the Stanford Research Institute, California, have developed an apparatus for growing high purity single crystals of refractory compounds. The method employed is a modified Verneuil technique, using arc image furnaces, which creates a clean heat source and complete atomsphere control.

Developed under the sponsorship of the US Office of Naval Research, this new facility has



A 45° control mirror diverts the light from either arc unit to a focusing mirror.

enabled Stanford engineers to produce single crystals, measuring $\frac{3}{8}$ in in diameter and 1 in in length, of clear rutile (TiO_2), in a pure oxygen atmosphere. They have also grown oxygen deficient rutile in an argon atmosphere and magnesium ferrite in an atmosphere of carbon dioxide. The equipment is currently being applied to the growth of high purity carbide, nitride and intermetallic single crystals.

The furnace consists of two arc units face to face. They are separated by a 45° control mirror which can be rotated to divert the light from either of the units to a vertical elliptical mirror which focuses the energy on top of a growing crystal. The use of the two arc units enables crystals to be grown for extended periods and is necessitated by the short burning times of the arc carbons.

Wire Strength Increased by Electropolishing

Electropolishing increased the ultimate strength of stainless steel wire by 30 per cent, says a report issued by the Southern Research Institute, Birmingham, Alabama. The research was carried out to study the feasability of using electropolishing to produce continuously tapered tow cables for US Air Force aerial targets.

The USAF is already towing aerial targets at distances over 25,000 ft and tow lengths up to 40,000 ft or more are expected in the foreseeable future. The principle limitation on the use of longer tow lengths is the drag and bulk of the tow cable itself. A significant increase in tow lengths and reel capacity would result if cables could be continuously tapered to provide a cross sectional area proportional to the strength requirements at every point along its length. No mechanical method for making continuously tapered wire is known; hence the research into electropolishing techniques.

Research has been concentrated on type 302 stainless steel wire and carbon steel music wire. The stainless steel wire increased in unit strength from 276,000 lb per sq. in, at its original 0·0495 in diameter, to 374,000 lb per sq. in after electropolishing to a 0·023 in diameter. The unit strength of the carbon steel music wire was relatively unchanged after a similar reduction in diameter by electropolishing.

It was concluded from these studies that electropolishing is a technically feasible method for making tapered tow cables and it has been recommended that a production plant be designed by the Southern Research Institute to produce tapered wire in sufficient lengths to evaluate under actual towing conditions.

Midget Wide-Angle Camera

A midget camera not much larger than a cotton reel is being mounted in guided missiles at the Woomera Rocket Range, Australia, to record details of target interceptions. It weighs 8 oz, is made of steel and is said to be virtually indestructible. An ultra wide angle lens gives a field of view of 186°, so that two cameras mounted back to back can provide coverage through 360°. Each camera takes one picture only, the shutter being operated by the firing of an electric fuse.

Known as Wreciss (Weapons Research Establishment camera interception single shot), it has been designed and developed at Woomera and is manufactured by Fairey Aviation Company of Australasia, at Salisbury, South Australia. It is primarily intended for the measurement of the attitude of a missile relative to its target and vector miss distance. The photographs may also show the horizon or ground features

Said to be almost indestructible, the midget camera has a view angle of 186° and an exposure time of 0·3 milliseconds.

and thus give a clear indication of the missile's attitude relative to the ground.

Miss distance can be measured to an accuracy of 5 per cent and the missile to target attitude (derived in conjunction with a wing-tip camera system) to an accuracy of plus or minus 1°.

The electric fuse requires 40 microjoules of electrical energy for fully reliable firing. This is obtained by the discharge of a capacitor through a thyratron at a voltage greater than 45 volts. The exposure time is 0·3 millisecond and the time interval between connection of the appropriate electrical circuit and the centre of the exposure period is 0·5 millisecond. The effective relative aperture is about f8 and a yellow filter is included in the system.

Semiconductors for Ultrasonic Cleaning

By using semiconductor devices instead of valves, the Westinghouse Electric Corporation, New York, United States, have reduced the weight of their ultrasonic cleaning units by 80 per cent. These ultrasonic generators, which are used in various types of industrial cleaning, are now 50 per cent smaller, 50 per cent more efficient, and more reliable than the previous units marketed by Westinghouse.

The development which has enabled the ultrasonic cleaning units to be so substantially improved is a multi-junction silicon, n-p-n-p device, called a trinistor. The silicon trinistor is able to switch from a blocking condition to a forward conducting condition when a suitable base signal is applied, and may therefore be used to convert mains energy to the 18 to 22 kc/s power required to drive the transducers used in ultrasonic cleaning.

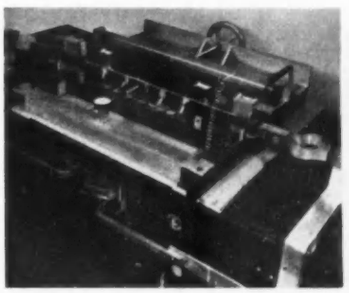
Since the new ultrasonic generators use solid state components exclusively and contain no thermionic valves or transformers, they have high inherent reliability and improved performance. Running costs of the equipment are also lower since the semiconductors are more efficient. Other improvements include the ability to start instantly, without any need for equipment warm-up; the ability to adjust output frequency semi-automatically so as to match changing load requirements during the cleaning process; and the absence from the equipment of high voltages, such as would be required with valves.

Resistance Strain Gauge Calibration

Resistance strain gauges for use at high temperatures can now be calibrated by a new technique developed at the Royal Aircraft Establishment, Farnborough. The new method employs a beam under four point loading which is heated by passing alternating current through it. Controlled, quickly variable temperatures up to 700° C can be obtained.

When stable conditions are reached the temperatures at points along the central section of the beam (where the gauges are mounted) may differ by as much as 10° C, but this does not seriously affect the accuracy of calibration. If the equipment is used to measure variations of resistance with temperature, or drift with time at a fixed temperature, the variation makes it necessary to measure the temperature at each gauge station.

The beam used in the equipment is made from nimonic 90 and is heated by alternating current of up to 600 amperes, fed through flexible copper strips. The beam may also be bent into a circular arc. It rests on rollers, bearing on two equally spaced pins. The bending moment is applied



The beam used in the equipment is made of Nimonic 90, which is heated by a current of 600 amps.

through further pins at each end of the beam. Deflection is measured with a sensitive Mercer dial gauge which is calibrated in ten-thousandths of an inch.

Measurement of the deflection allows the strain to be accurately calculated and related to the strain gauges which are adhering to the beam. When in use, the beam is covered by concentric boxes of aluminium sheet enclosing asbestos meal. The dial gauge is provided with an insulating extension piece which keeps it at room temperature.

The heating circuit is controlled by servo, which eliminates hunting, and power input to the beam is varied by suppressing a variable proportion of the supply waveform, using thyratron trigger circuits. The proportion suppressed is controlled by the variable resistance of a platinum element attached to the beam.

Table Top Cookery

The Culinaire series of cooking appliances allows most dishes to be cooked actually on the table. All are thermostatically controlled and have suitable cooking temperatures engraved on the handles.

If you want to have your meals really hot, the answer is surely to cook them on the table. Then the gourmet can watch his steak or omelette reaching the desired pitch of perfection and transfer it to his plate at precisely the right second—when it is exactly done and not the least shade overdone. Also, if you have to live in one room, it saves having to devote too much precious space to kitchen activities.

There have been many attempts, of course, to keep food hot at the table (or, in some establishments, on the sideboard) and the hot-water dish was undoubtedly one of the earliest of these efforts. But it is heavy and clumsy—a relic of the days of many servants. In many an Edwardian drawing room could be found a copper kettle precariously balanced on a stand with, below it, a small (but mightily efficient) spirit lamp. It certainly ensured that the tea was hot! A direct successor is the spirit-heated coffee percolator, always reminiscent of an ancient alchemist preparing some mystic brew in an alembic or a dragon. The modern electrical equivalent, though highly efficient and an excellent example of table top cookery, lacks this element of excitement.

The full development of table cookery had to wait for electricity and even now it is rare though its use is growing. The United States led the way, but even there, in 1954, the sales of such appliances only just topped the million. Four years later sales had passed the twenty-million mark, and 36 out of every 100 homes with electricity had a fry-pan cooker. After a slow start, sales in Britain are now rising rapidly and several makes are available.

The illustration shows the Culinaire range of appliances. It includes a large griddle-hot plate (18½ in by 11½ in); fry-pan cooker; casserole; cooker-boiler (two sizes, 8 in and 9½ in diameter); and Dutch oven. All of them have the actual cooking part cast in LM8 aluminium to British Standard requirements and have the other parts of stainless steel or aluminium. Handles are phenolic resin. The glass lids are also designed for use as serving dishes. Operation is from standard mains supply at 200/250 volts alternating current, and the ratings vary from 1,200 to 1,500 watts.

A particular feature is that all of them have thermostatic control. The thermostat, which can be set anywhere in the cooking range from full heat (400° F) to merely keeping the dish hot (150° F), is contained in the plug lead; it is shown in place in the Dutch oven in the centre. It is, therefore, withdrawn when the lead is removed, so enabling the pan to be totally immersed for washing up. The same thermostat can be used in any one of the appliances.

The thermostat is a probe unit with a special track-resisting ceramic insulator and is arranged to work on a microswitch principle to give long life and to obviate radio interference. An indicator light glows until the correct temperature is reached and also marks the setting of the thermostat. The heating elements are mineral insulated and cast into the bases of the appliances to give a quick heating-up period, with good heat transfer. The arrangement also makes the appliance very robust and seals the element against the entry of water when washing up. An intriguing point is that the appliances can boil their own washing-up water The majority of normal cooking operations can be carried out and there is the added advantage of lightness of handling, which in any case is reduced to a minimum. Cooking temperatures for many dishes are engraved on the handles.

Another appliance of similar type is an electric skillet made by Morphy-Richards. It is claimed to be able to braise, stew, fry, roast and bake with this unit, which measures 9½ in wide, tapering to 9 in, by 9½ in long. The pan is 1⅜ in deep. The lid is copper-toned anodised aluminium and is fitted with an adjustable vent to control the escape of moisture according to the dish being prepared. A baking tray is included.

Like the Culinaire series, it has an adjustable thermostat for temperature control, giving a range from 400° F to 150° F for keeping food hot. A pilot light is included to indicate that the current is switched on. The surface of the pan is siliconised to obviate the need for "breaking-in". A list of cooking temperatures is engraved on the main handle as a guide and there is an opposed handle to steady the pan when being moved. The element, which is sealed in the pan to allow for washing-up, is rated for 1,150 watts at voltages between 200 and 260 V, alternating current.

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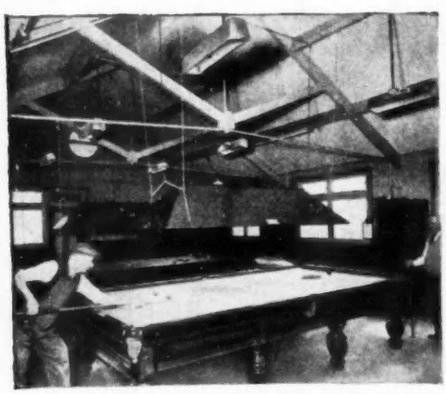

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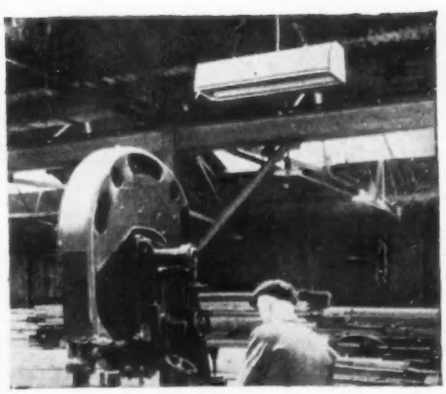

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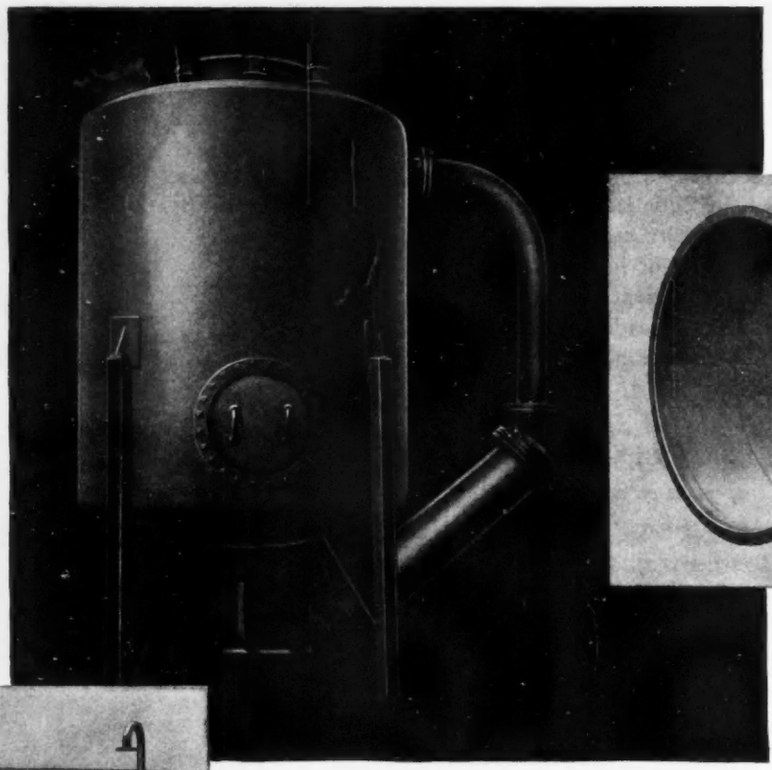

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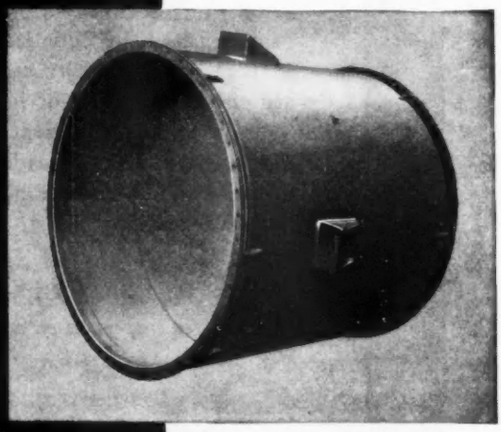

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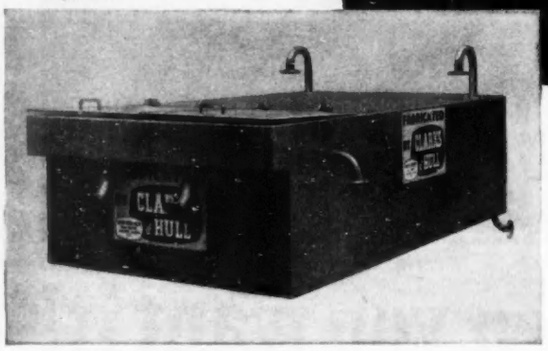

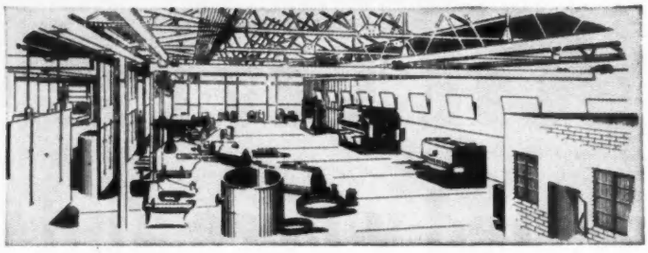

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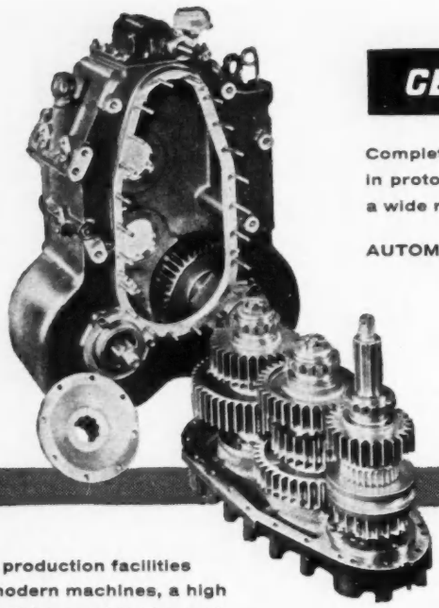

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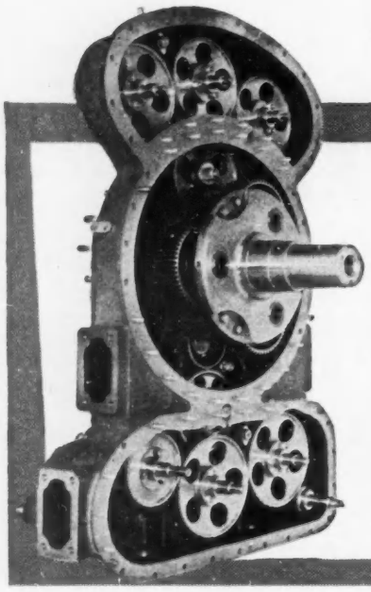

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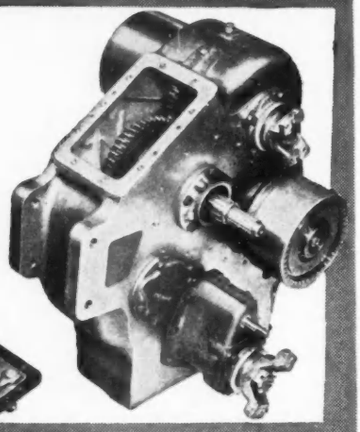

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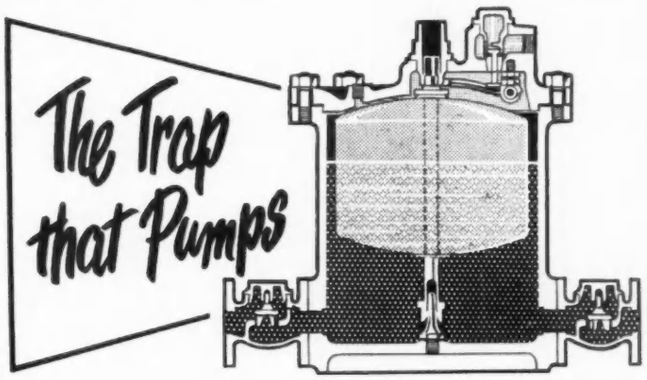

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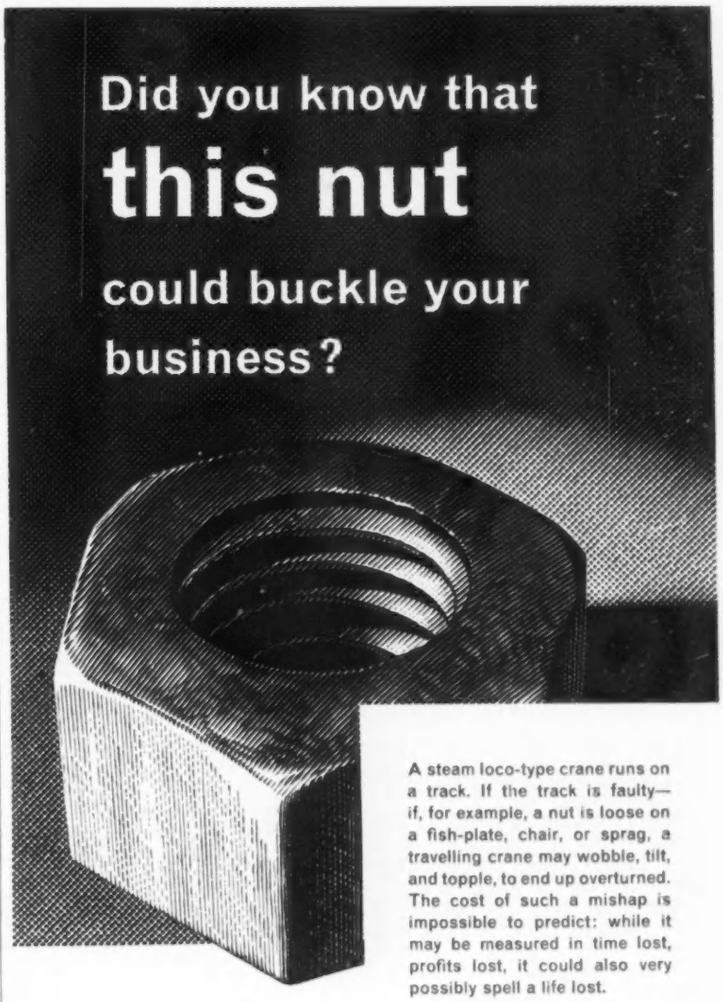

A steam loco-type crane runs on a track. If the track is faulty—if, for example, a nut is loose on a fish-plate, chair, or sprag, a travelling crane may wobble, tilt, and topple, to end up overturned. The cost of such a mishap is impossible to predict: while it may be measured in time lost, profits lost, it could also very possibly spell a life lost.

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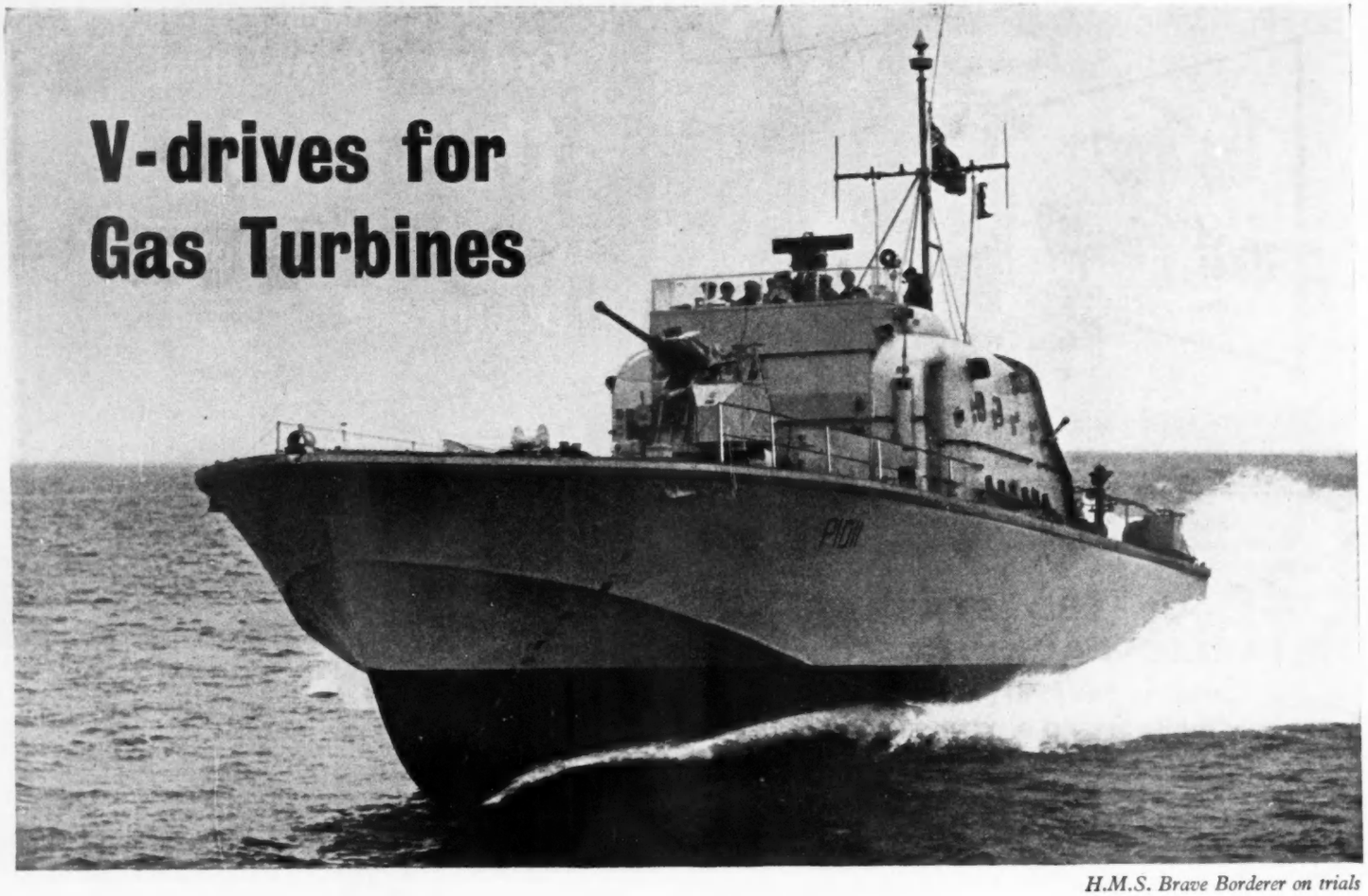

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AP 115

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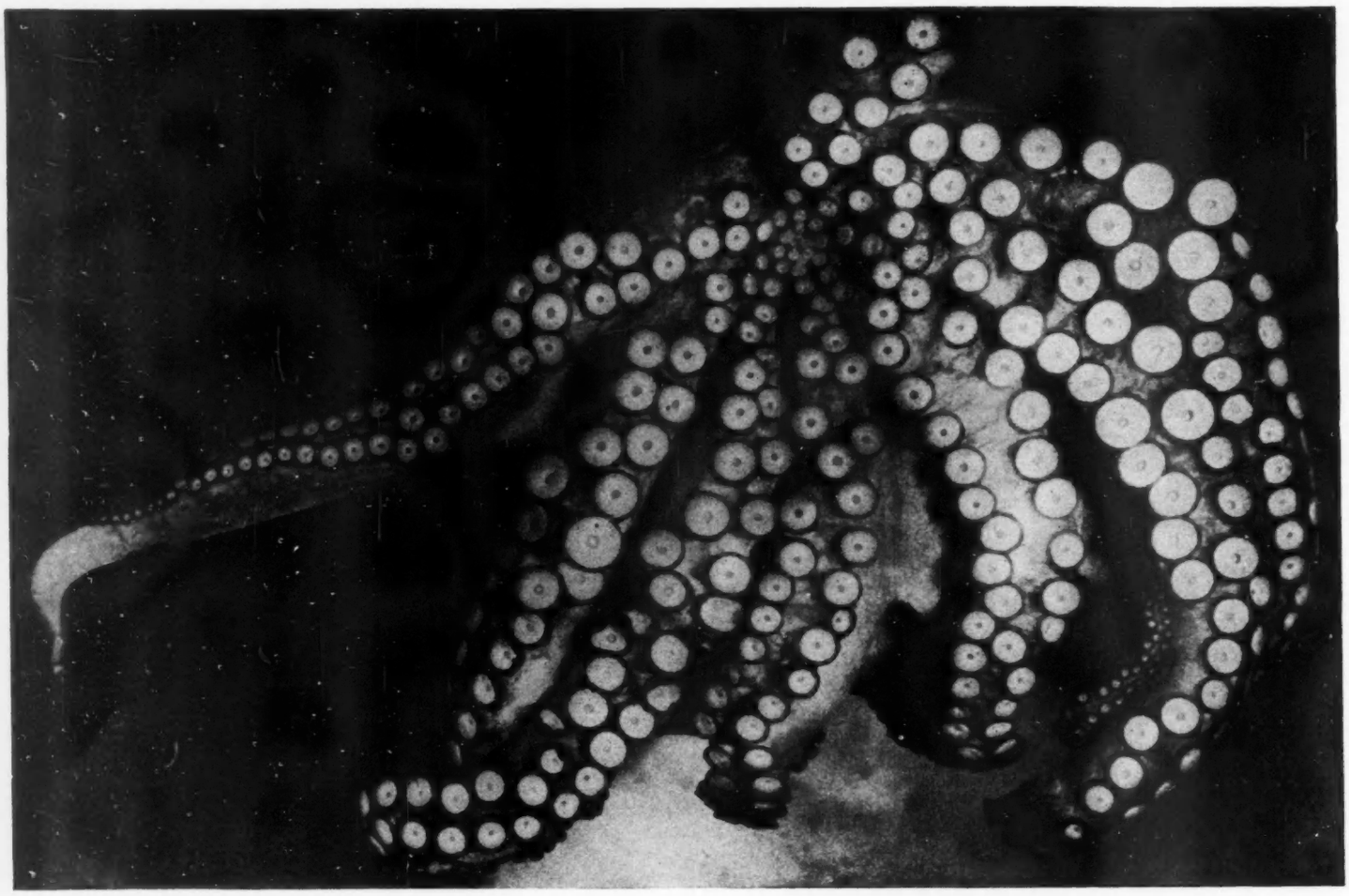

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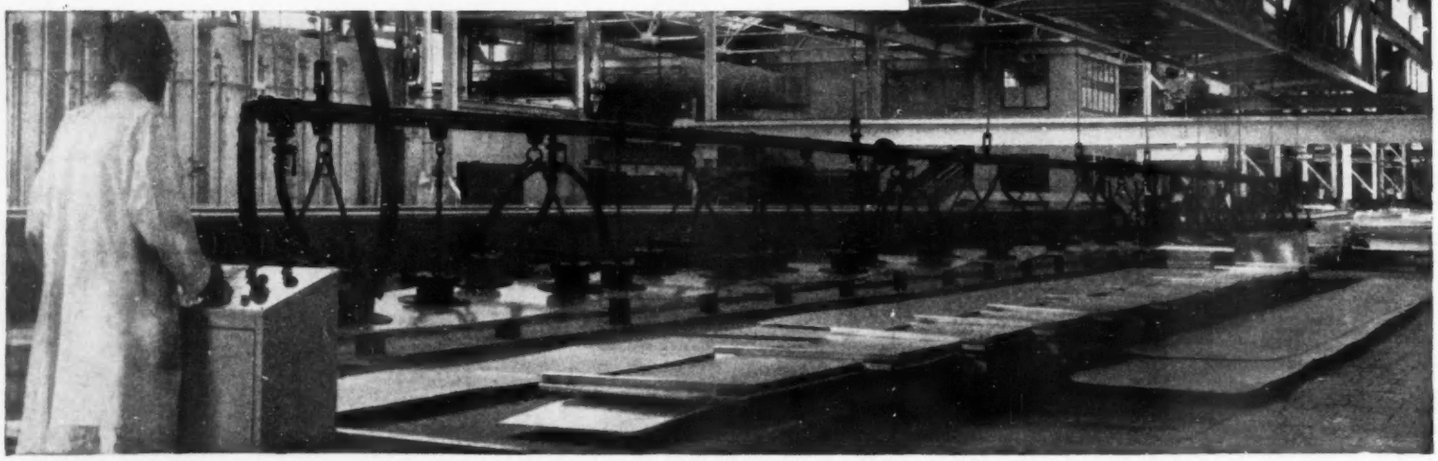

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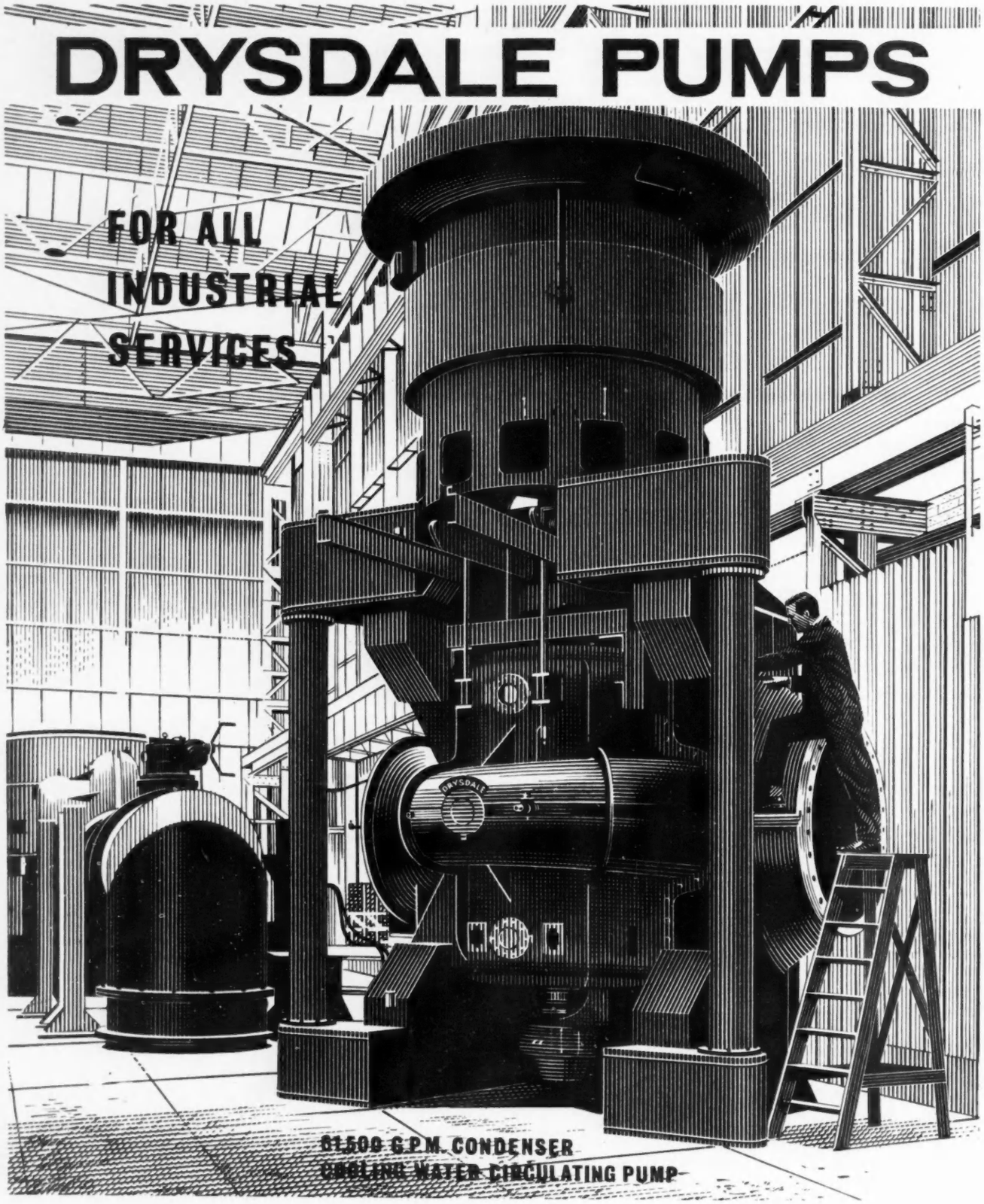

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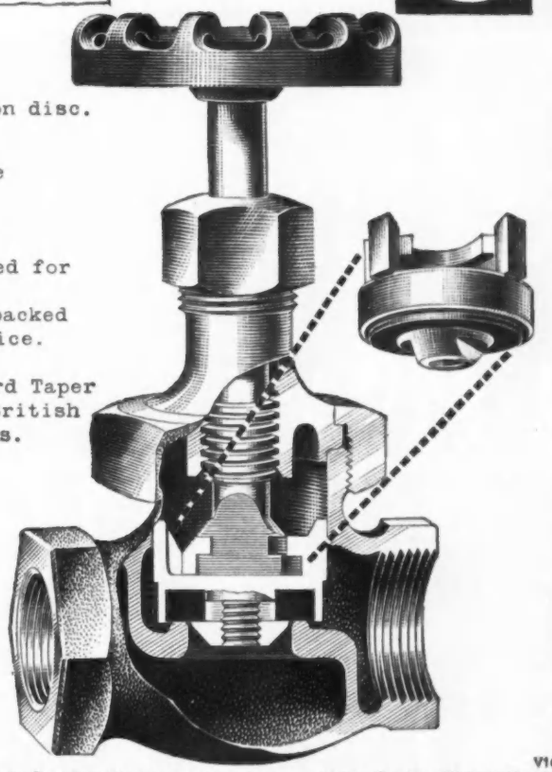

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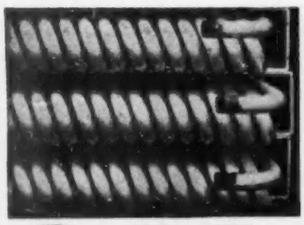

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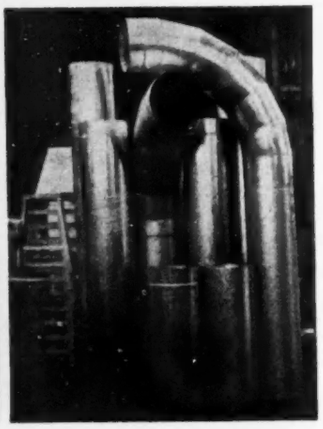
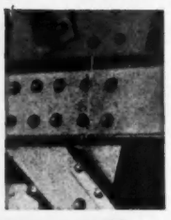
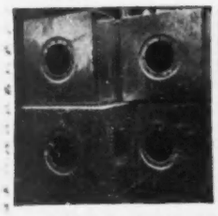


FIRST MAKES STEEL LAST





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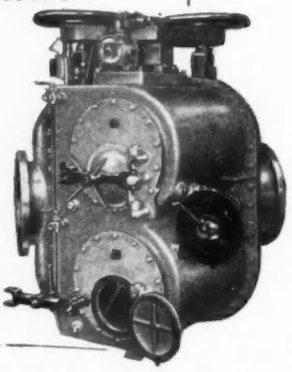

The illustration shows one of four 20in. bore Royles Type "E" Twin Water Strainers as supplied to the Lummus Co., Ltd. for Shell Haven Refinery. Owing to handling difficulties the cages in this type of strainer are not removable. Access for cleaning purposes is provided by quick-release doors. Royles new development feature consists of motorised valve changeover gear with a flameproof electronic switch giving automatic "off" control of the valve travel in either direction. Manual operation is provided for alternative use.

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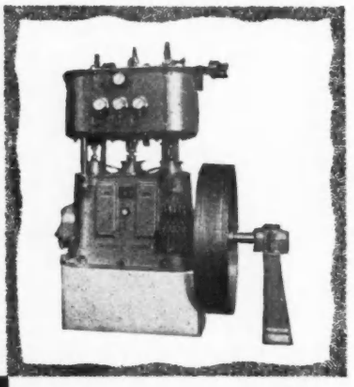

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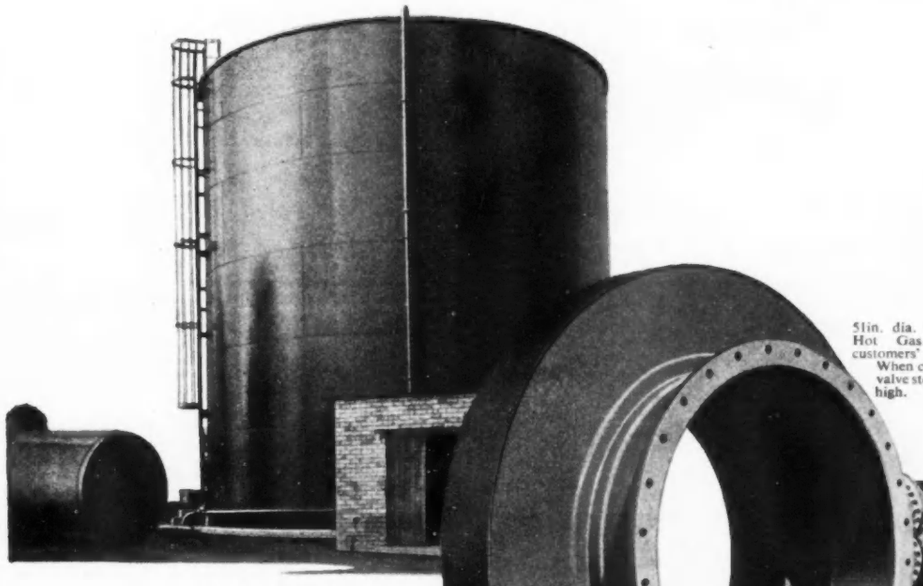
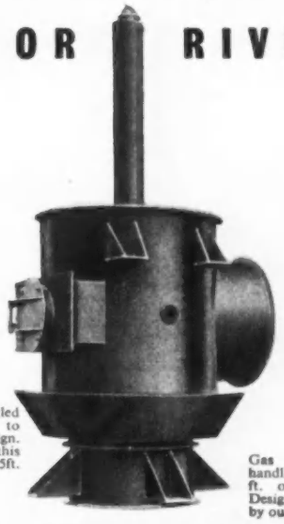
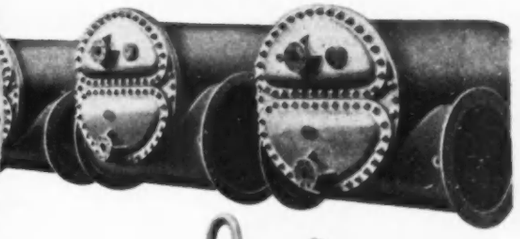


36ft. dia. by 37ft. high open top, all butt-welded Tar Storage Tank.



51in. dia. water sealed Hot Gas Valve to customers' own design. When complete, this valve stood over 15ft. high.



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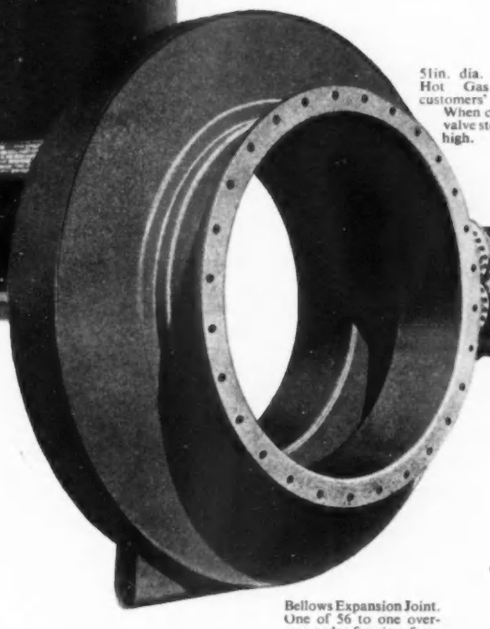

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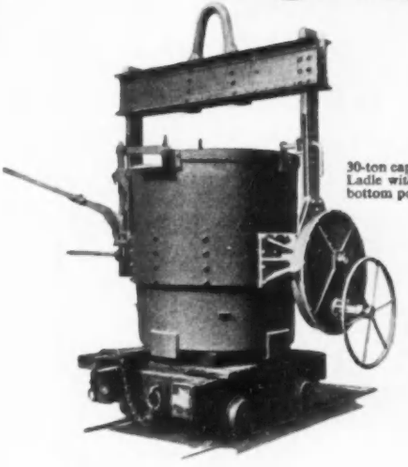

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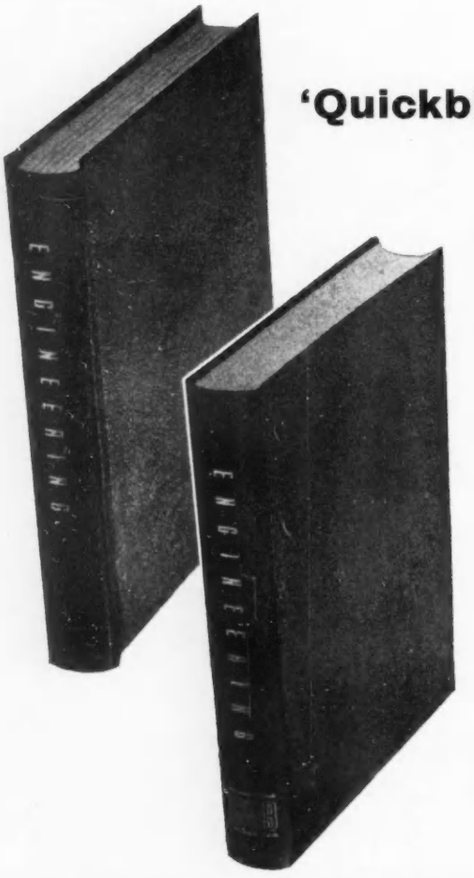

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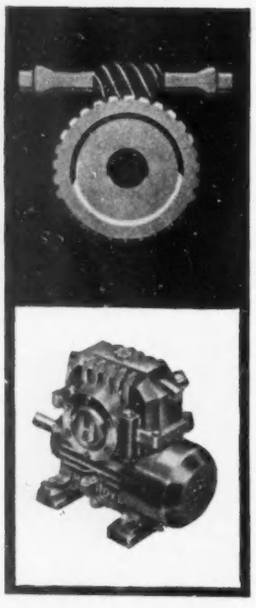

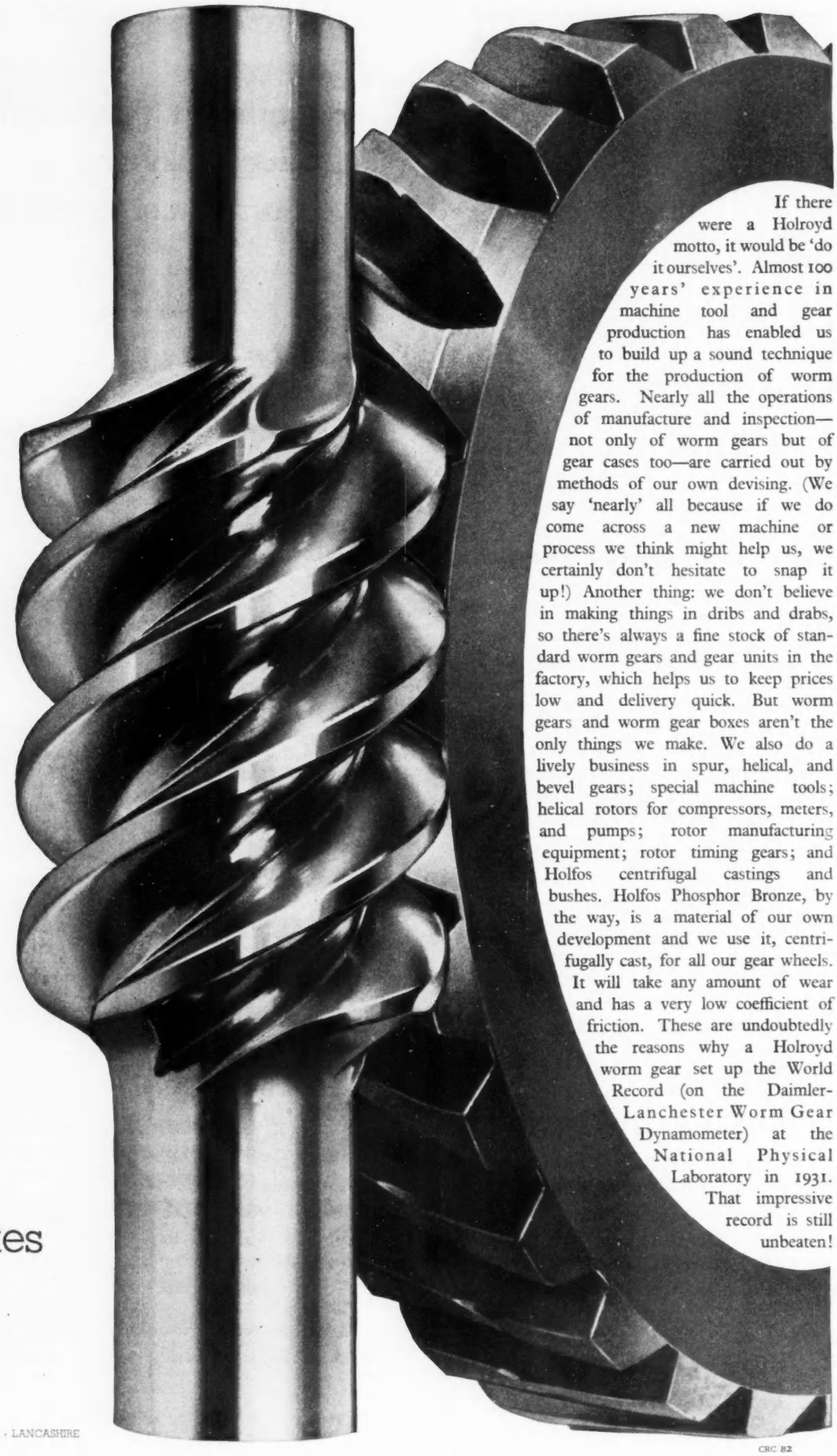

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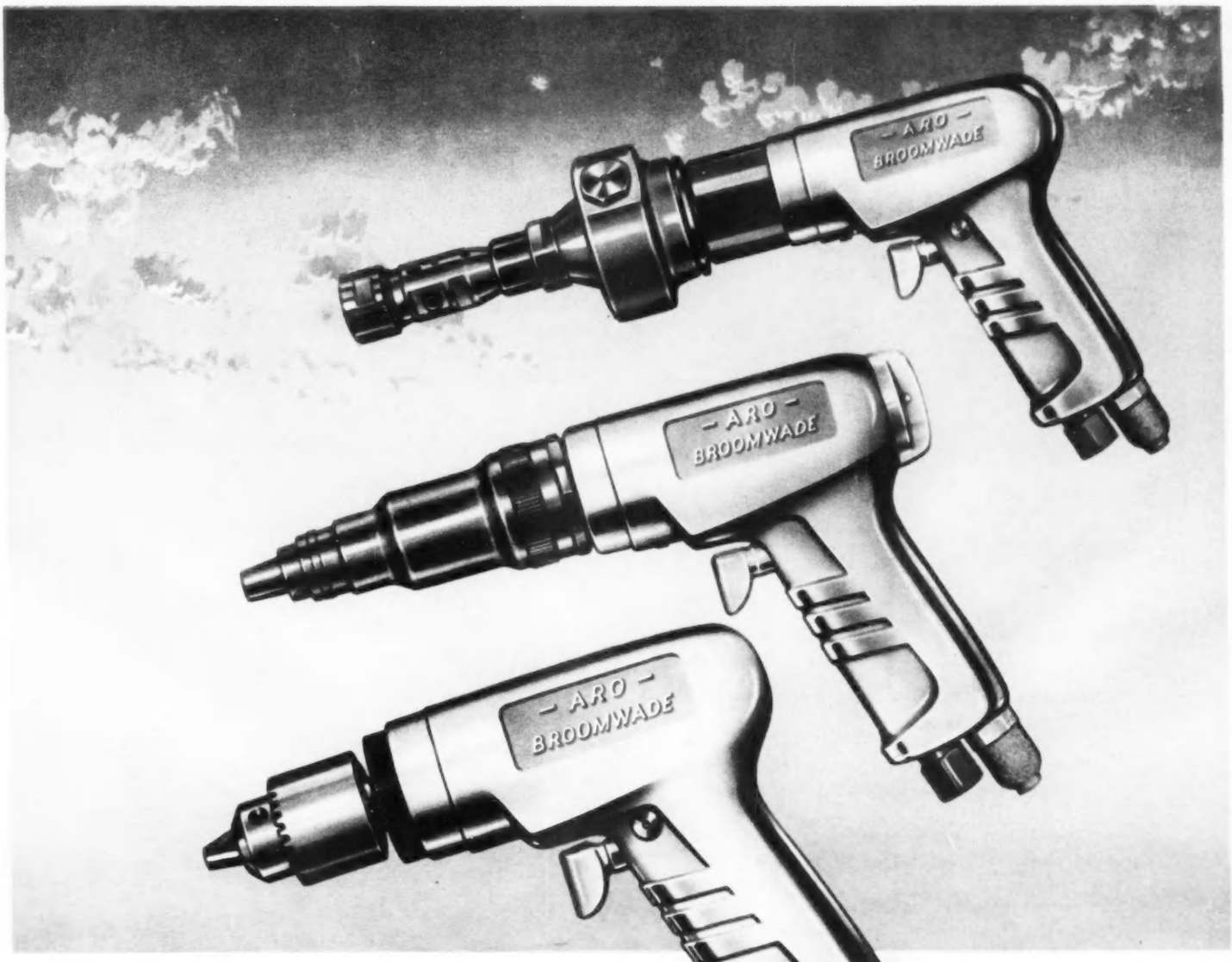

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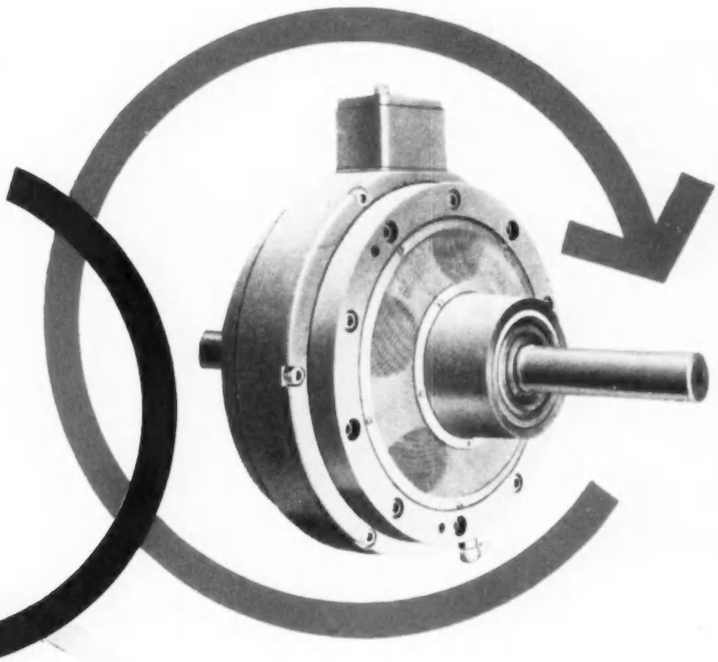

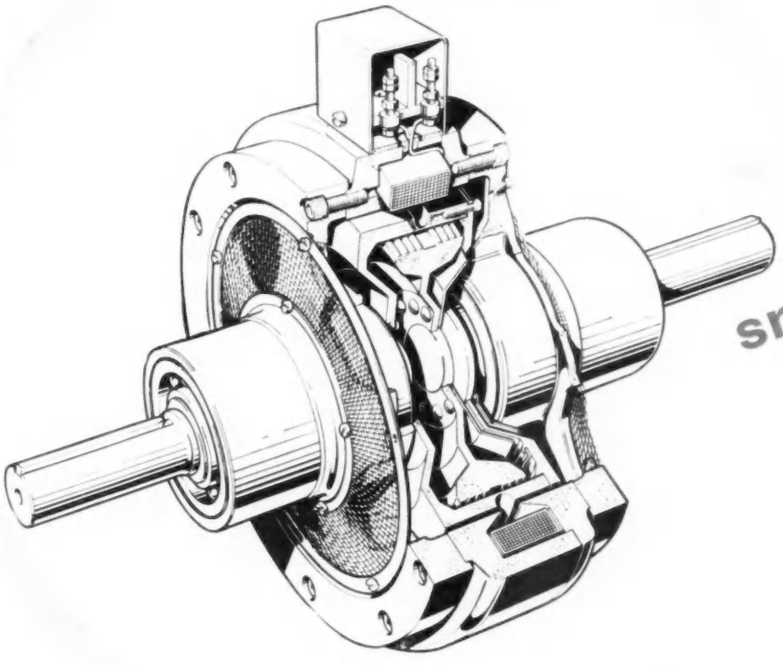

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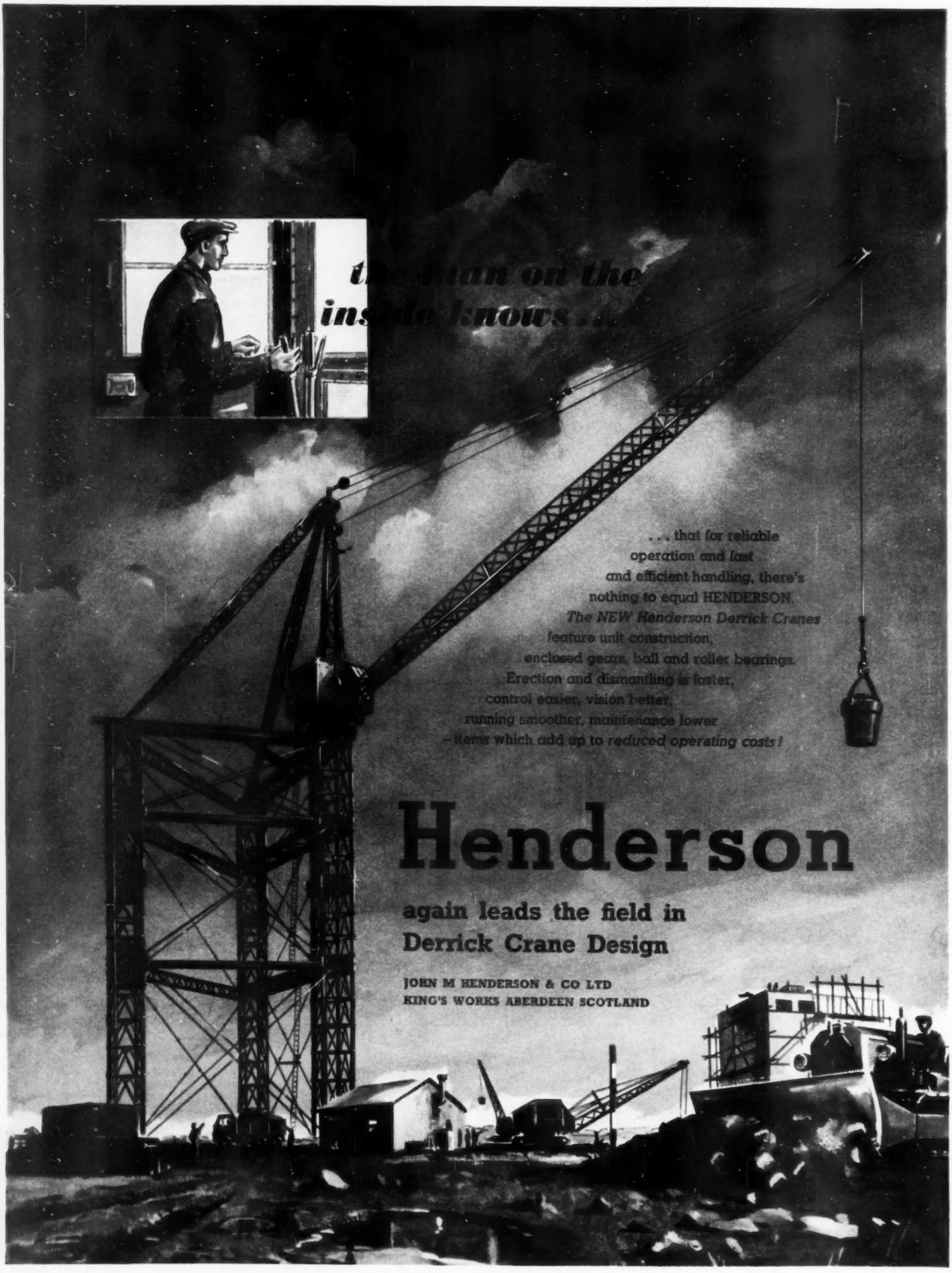
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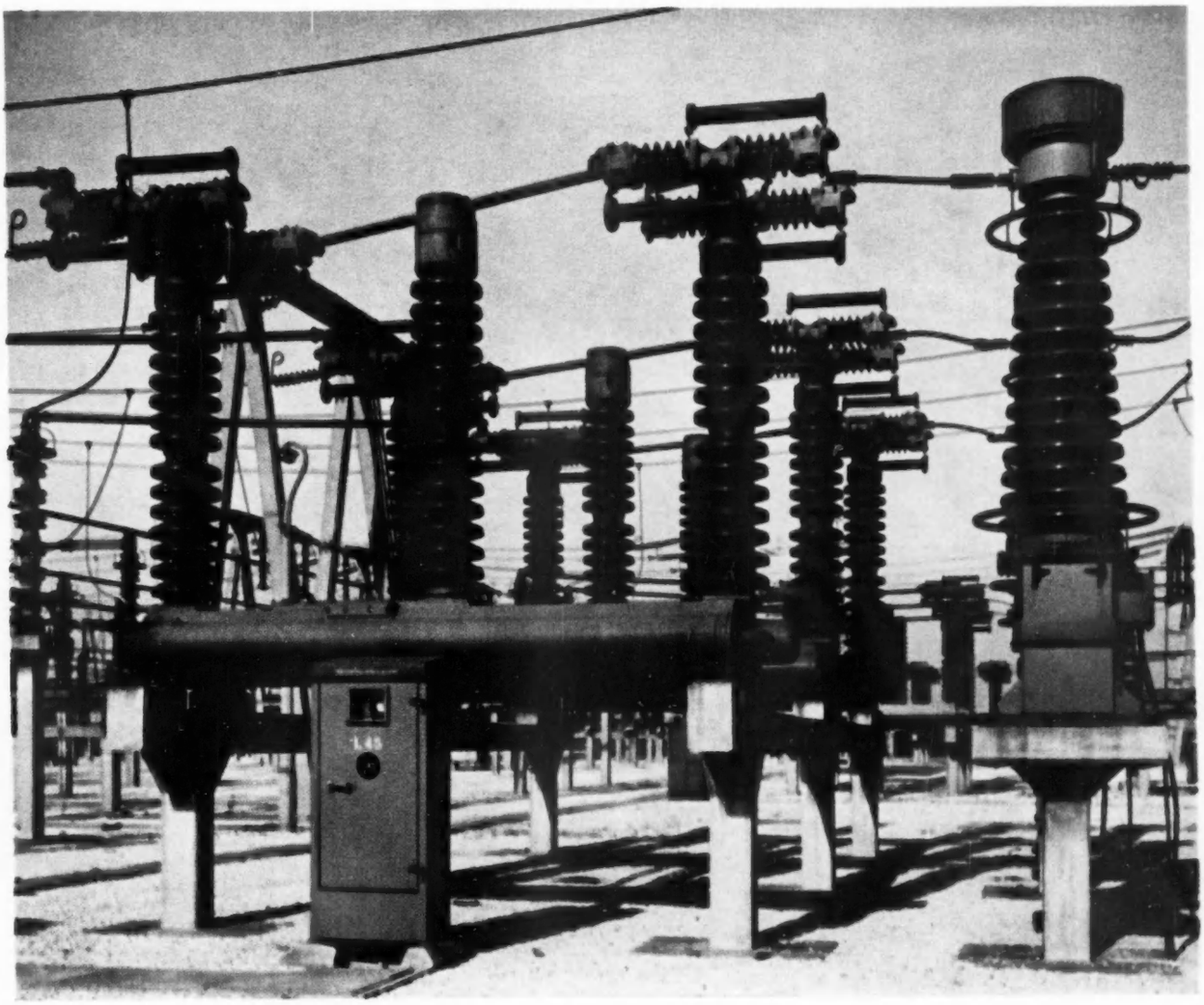

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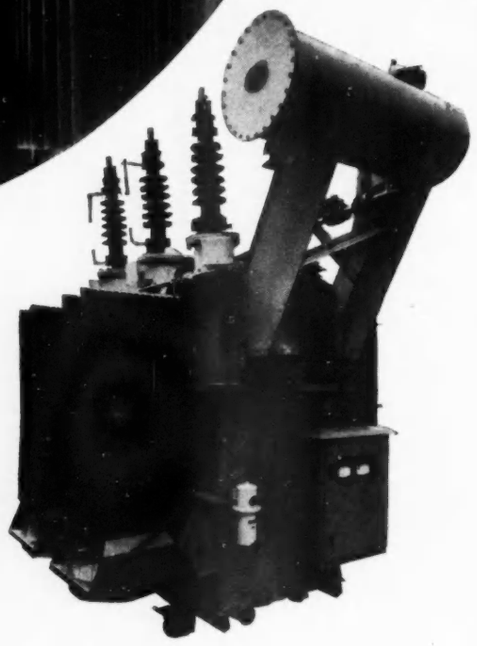

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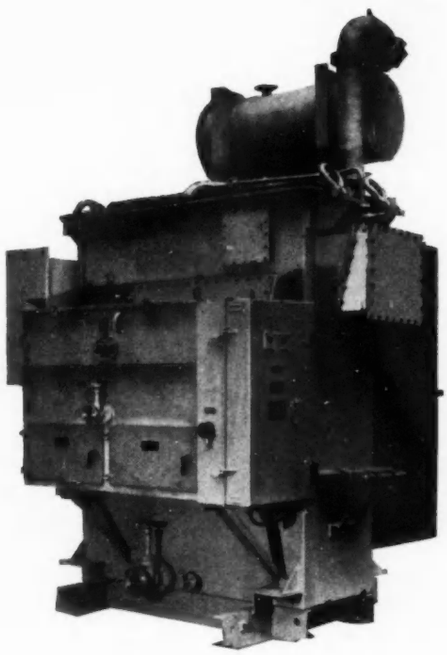
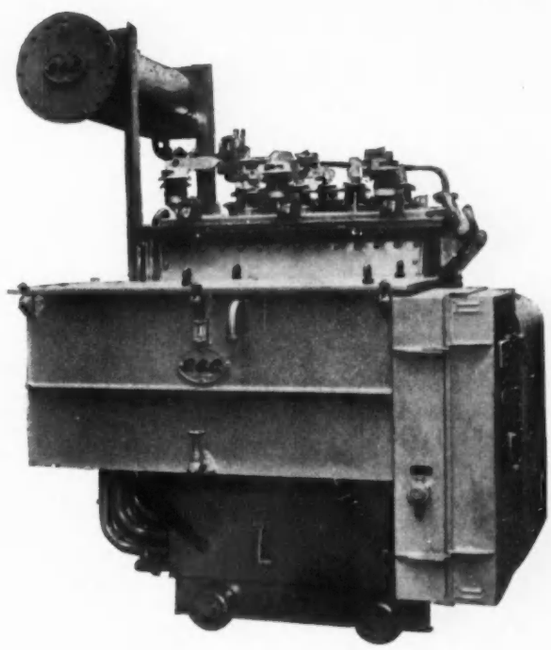


CANADA 2500 kVA 13.8/2.4 kV 60 c/s transformer fitted with on-load tap-changing switch for Niagara.



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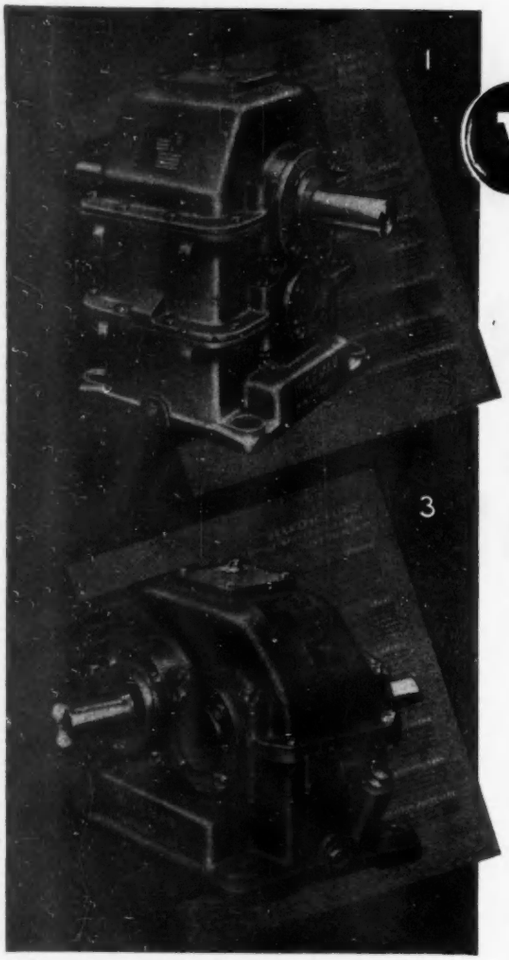

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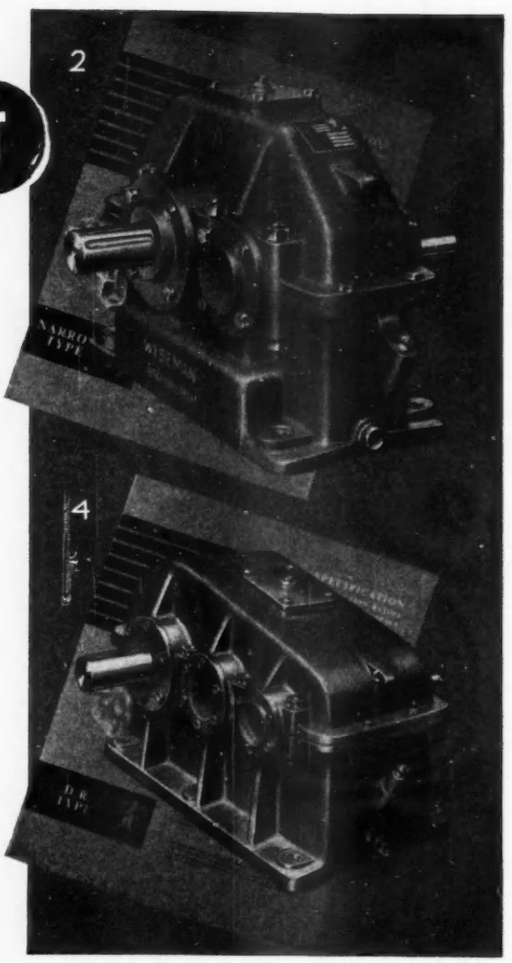

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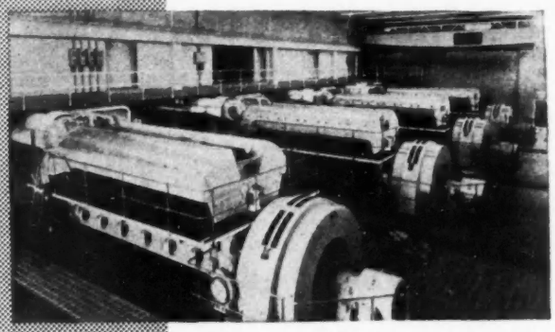
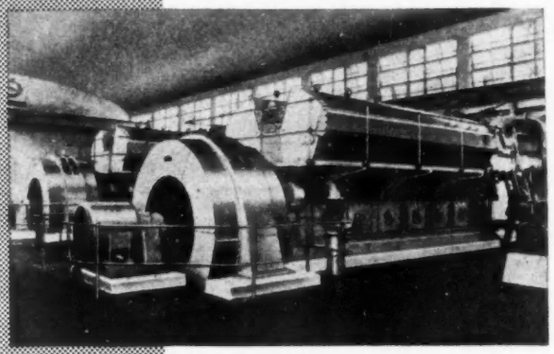
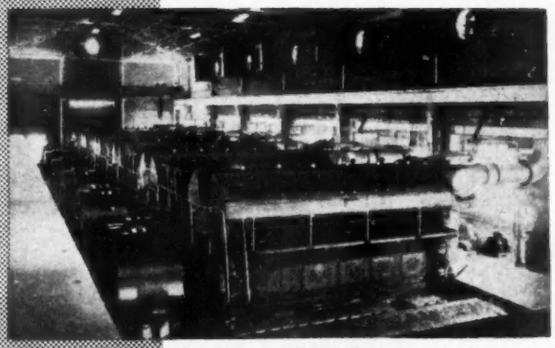


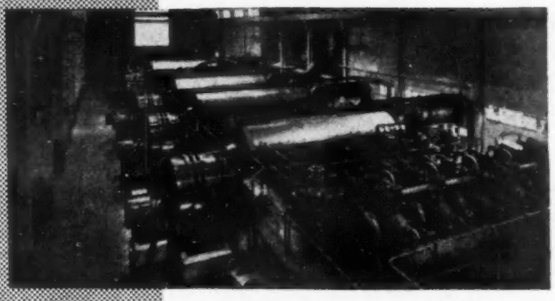
Four Mirrlees KVSS12 Engines each developing 3240 B.H.P./2250 kW at 450 r.p.m. Installed at John St. Pumping Station, Toronto, Canada.



Two of six KVSS12 Engines each developing 2484 B.H.P. 1742 kW at 428 r.p.m. Installed at the Central Electricity Board, Mauritius.



Six Mirrlees KVS12 Engines each developing 1777 B.H.P./1242 kW continuously on site at Lyallpur Power Station, Pakistan.



Seven Mirrlees KVSS12 1800 kW, and two KVSS16 3000 kW generating sets installed at the Jersey (Channel Islands) Power Station at St. Helier.

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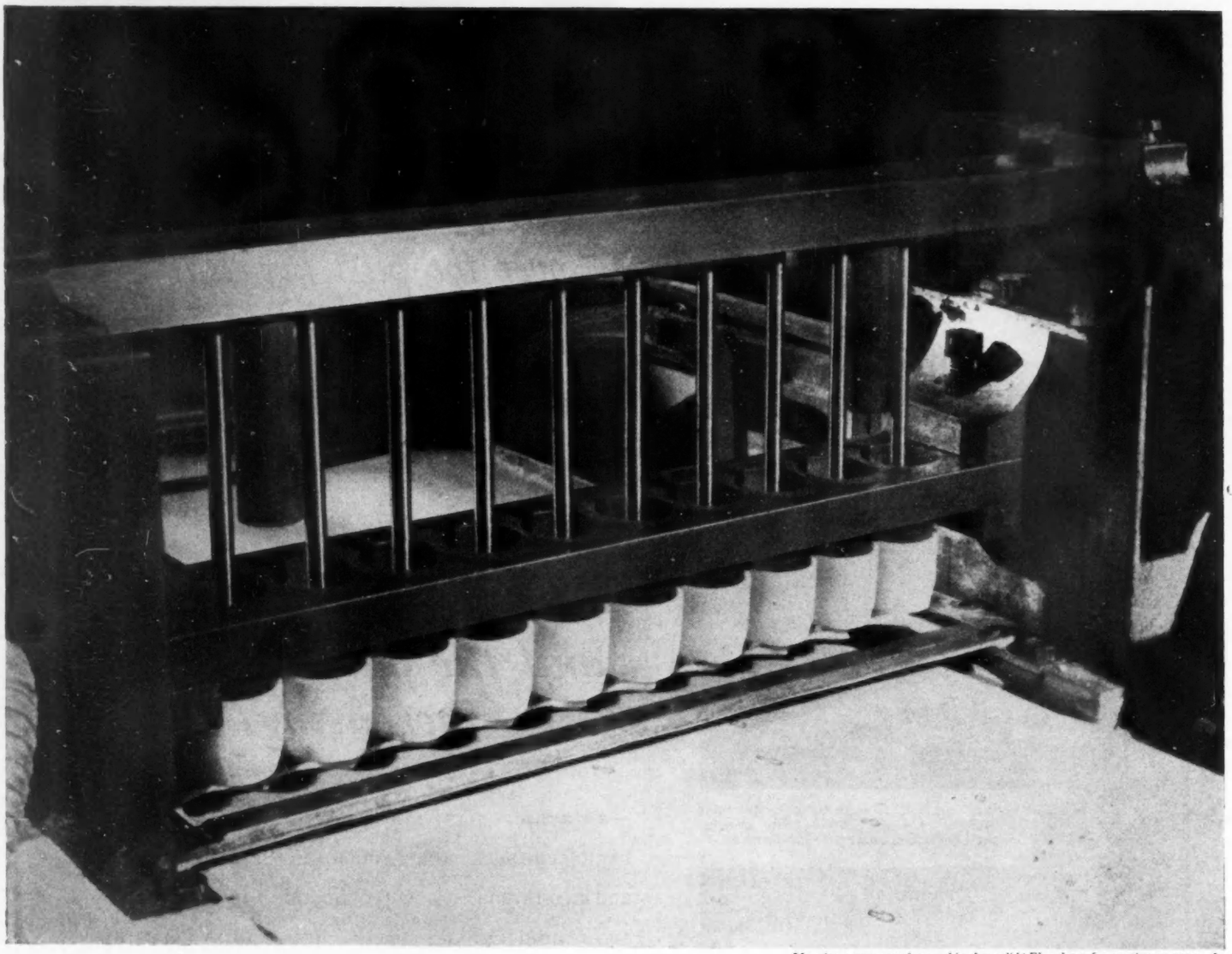
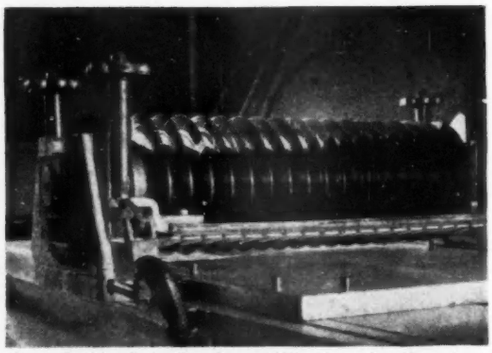


Marzipan centre cutting machine has solid 'Fluon' p.t.f.e. coating on cutters, base plate and release plungers. The work was done by Crane Packing Ltd., Slough, for John Mackintosh and Sons Limited, Norwich.

Non-stick surface makes 'Fluon' ideal for use in marzipan cutting machine

MARZIPAN cutting machines at the Caley Works of John Mackintosh and Sons Ltd., Norwich, always maintain an even flow of production. With a product like marzipan, this is not usually an easy thing to achieve. Marzipan tends to stick to metal surfaces of a machine—on cutting blades and plates, for instance — which means that automatic handling of marzipan is uneconomical. Crane Packing Ltd., Slough, have used 'Fluon' p.t.f.e. dispersion and solid 'Fluon' p.t.f.e. to coat cutters, the rotary cutters, the base plate and the release plungers because of the excellent non-stick properties of 'Fluon' p.t.f.e. This enabled John Mackintosh and Sons Ltd. to change over to automatic handling of marzipan.

As well as having a non-stick surface, 'Fluon' is invaluable on a confectionery machine because it will not taint food in any way. 'Fluon' is a tough, flexible material, is extremely long-lasting and has an outstanding range of properties which commend it for use throughout modern industry.



Crane Packing Ltd., Slough, used 'Fluon' p.t.f.e. dispersion to coat the blades of the rotary cutter and used solid 'Fluon' p.t.f.e. strips on the base plate to prevent marzipan sticking to the automatic cutting machine in Caley Works, John Mackintosh and Sons Ltd.

'FLUON'

'Fluon' is the registered trade mark for the polytetrafluoroethylene manufactured by I.C.I.

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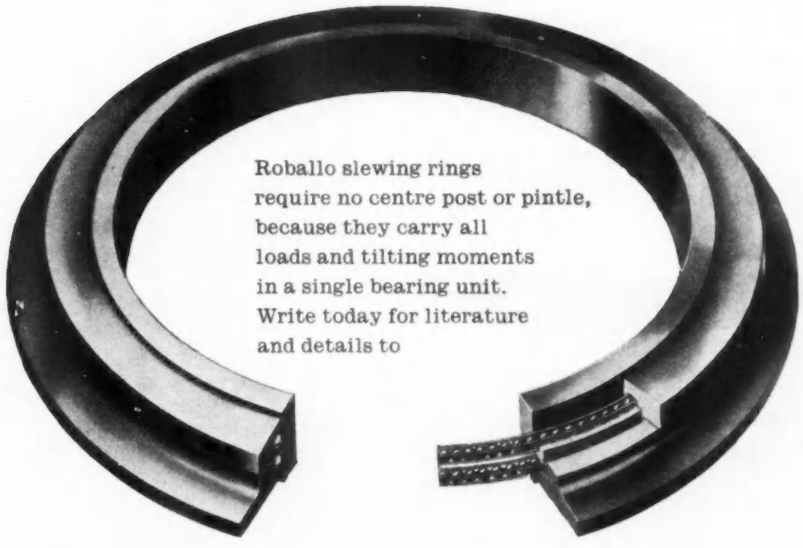

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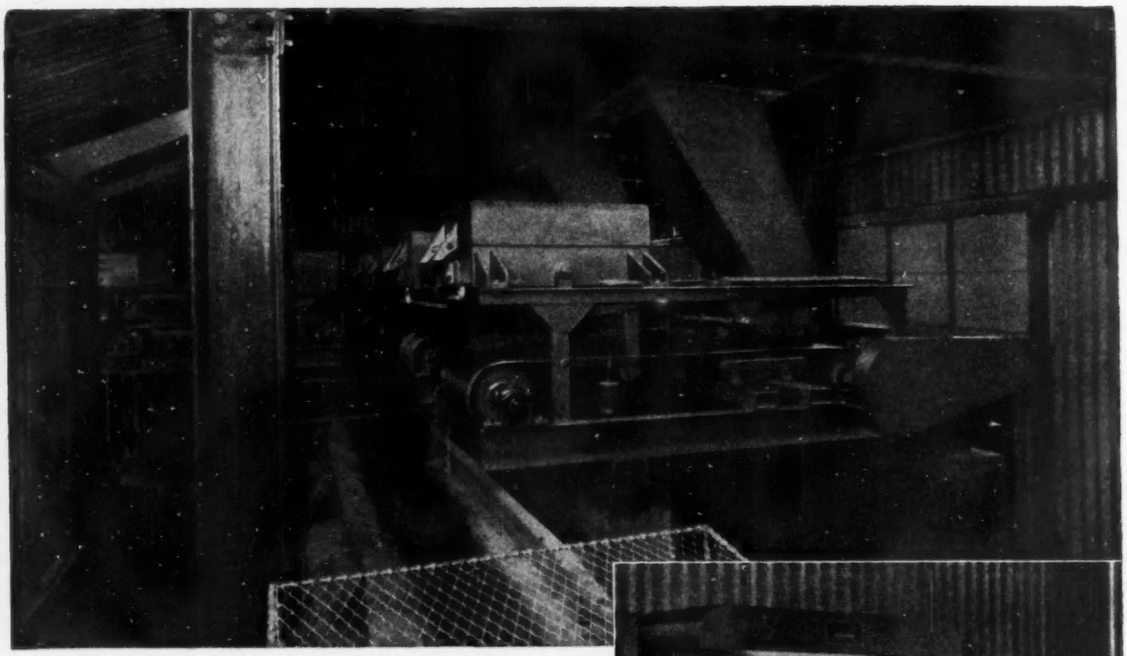

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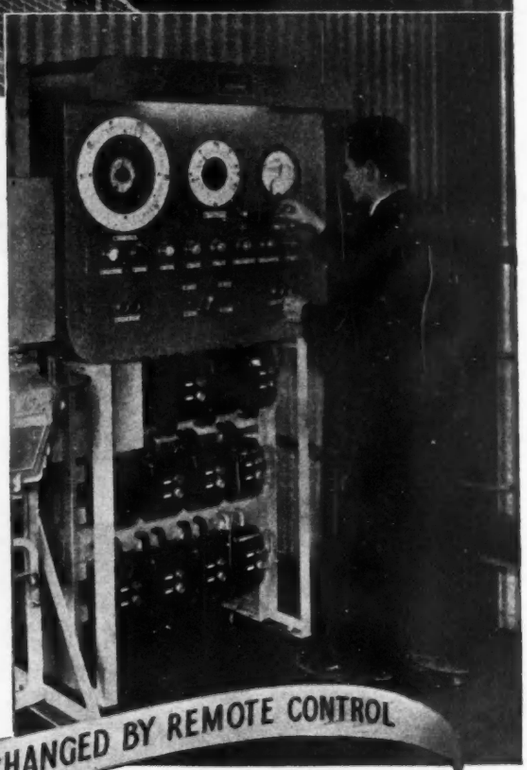

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A PLESSIFLEX application on the Bristol Bloodhound.

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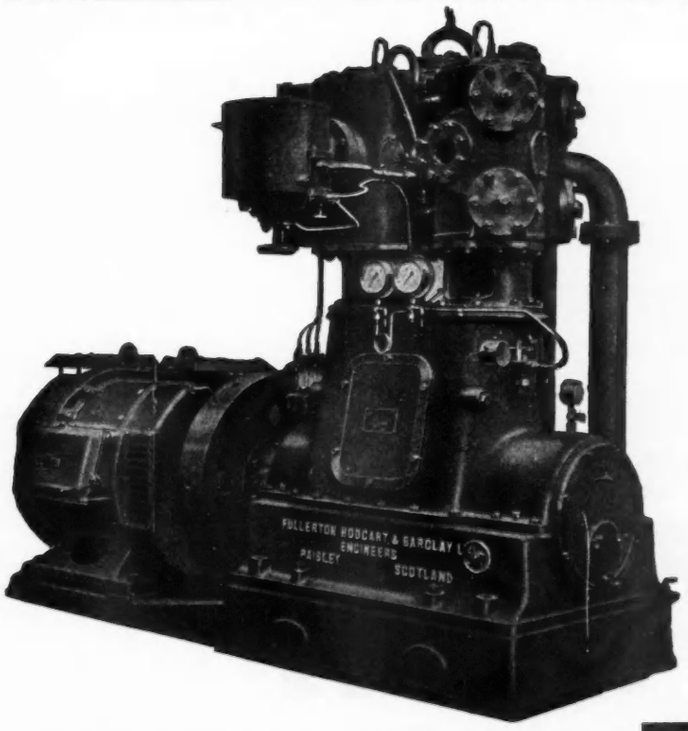

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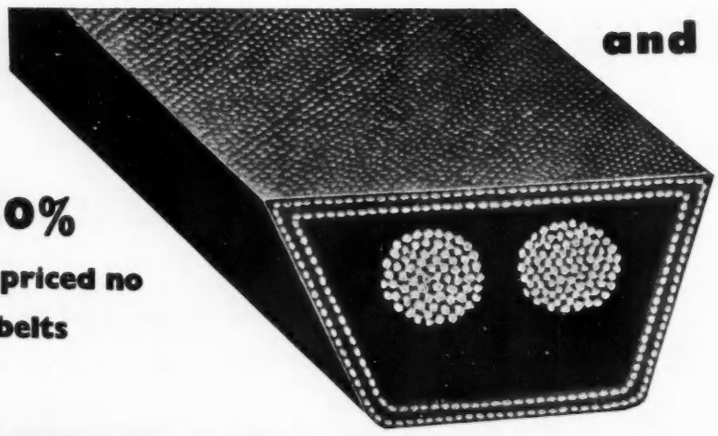

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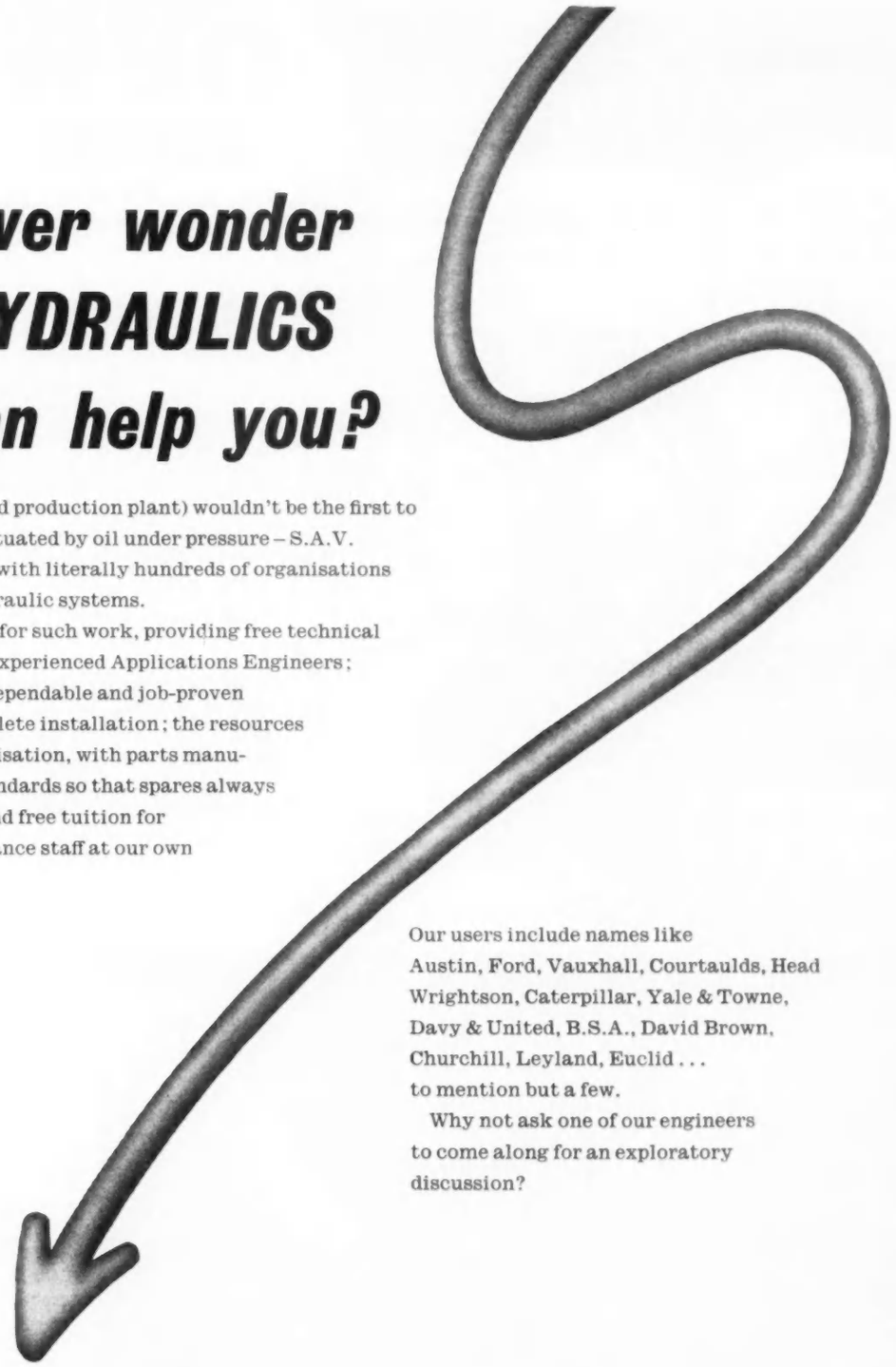

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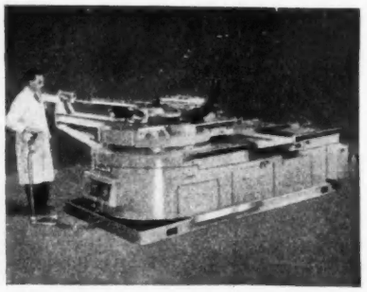
TYPE MSA 6

A heavy duty Mandrel Bender of completely new design and massive construction with all mechanical drive to produce full bore bends on standard or on extra short radii in heavy gauge mild and stainless steel tube up to 6½ in. O.D. and in non-ferrous tube up to 8¼ in. O.D.



The Hilmor range of over 30 models includes hand operated and hydraulic portable machines, hand and power operated general purpose machines and power operated high output repetition benders. Most models can be tooled to bend square, oval, and other non-round tube, angles, extrusions, etc.

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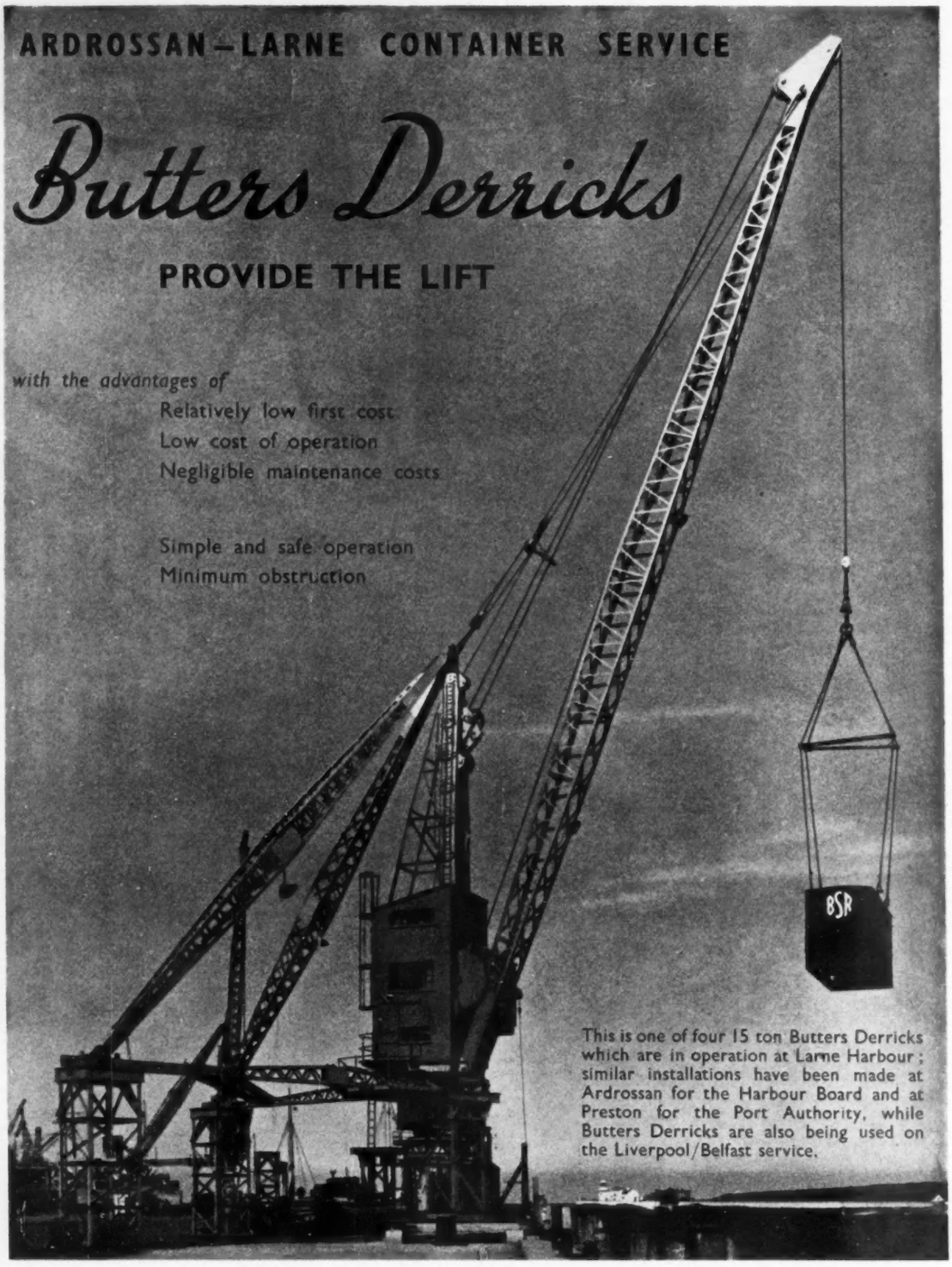
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This is one of four 15 ton Butters Derricks which are in operation at Larne Harbour; similar installations have been made at Ardrossan for the Harbour Board and at Preston for the Port Authority, while Butters Derricks are also being used on the Liverpool/Belfast service.

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are now being produced to meet a demand for essentially simple and completely reliable cranes for the heavy duties involved in nuclear power station construction and elsewhere.

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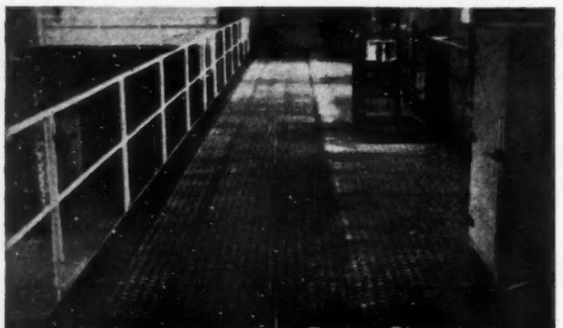
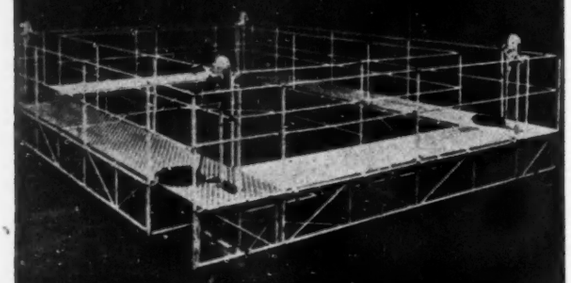
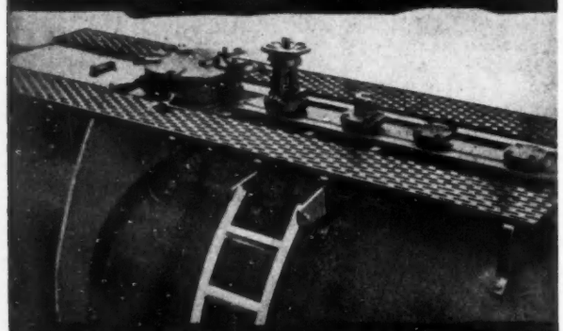


Alaflor installed in Radio Chemical Laboratories at the National Chemical Laboratory, Middlesex.



Alaflor suspended staging for inside boilers, as used by Sterling Safway Scaffolding, Jarrow.



Alaflor platforms supplied to Charles Roberts & Company Ltd., Wakefield, for Fisons Limited tank wagons.

Removable Alaflor platform supplied to Northern Lighthouse Board for North Uist Lighthouse.

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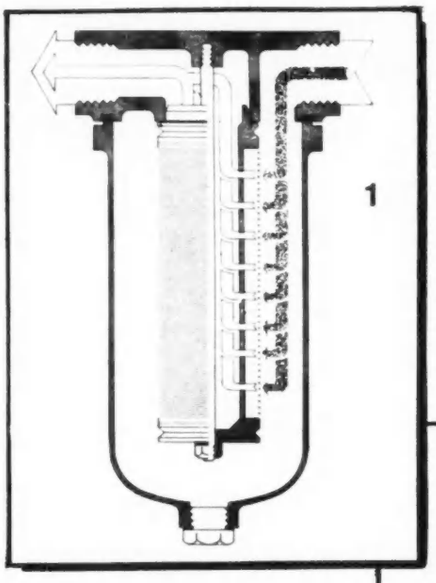
INSIDE INFORMATION

ON MODERN FILTRATION TECHNIQUES



AUTO-KLEAN LOLOS (1)

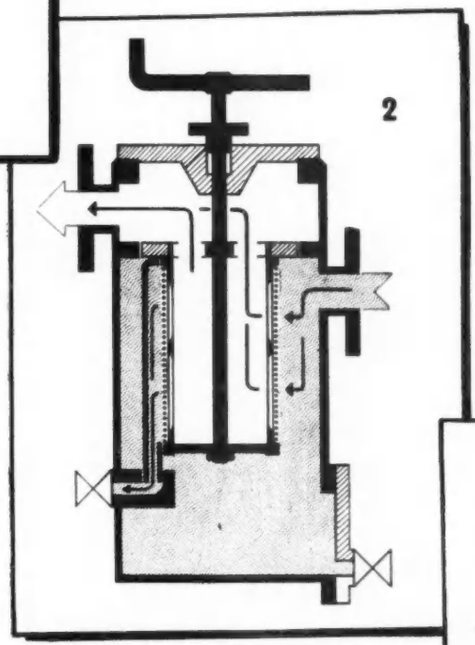
This is a range of filters incorporating wire-wound elements designed for ultra fine filtration of low to medium viscosity fluids under pressure.

Principle: A ribbed cylindrical former is screw cut, and a continuous monel or stainless steel wire is tightly wound into the grooves. By altering the pitch and or the diameter of the wire defined alterations of mesh can be accomplished. LOLOS L.F. filters have a fabric sleeve fitted over a fine mesh wire-wound element.

Advantages: AUTO-KLEAN LOLOS filters ensure ultra fine filtration *with negligible pressure loss.* Their robust construction remains non-collapsible under extreme pressures, requiring practically no maintenance. Also important is its small lightweight construction.

Data: Working pressures can be arranged up to 2,000 lb sq.in. Also included in the range are duplex and multi-element designs.

Typical Applications: Hydraulics; fuel and lubrication systems in air, sea and land transport, cooling circuits; distilleries; irrigation lines; washing and bottling plants, etc.



AUTO-KLEAN FLUSHFLO (2)

This is a range of self-cleaning filters specifically designed for continuous operation in the cooling and lubricating systems of heavy machinery.

Principle: Sludge collected by a wire-wound element is dislodged by reverse flow, while the filter element is electrically or manually turned. In contact with the wire element is a spring-loaded slotted tube which acts simultaneously as 'scraper' and discharge passage.

Advantages: The FLUSHFLO is completely self-cleaning while in service without interruption of liquid flow. It ensures fine, positive full-flow filtration with very low pressure losses. And, because the sludge is removed automatically without dismantling, its use leads to reduced maintenance costs. FLUSHFLO filters are also noted for their large capacities relative to size.

Data: Capacities and mesh dimensions fully tabulated in Auto-Klean literature. Quotations on request for processes and capacities not already covered.

Typical Applications: Large scale oil and water cooling circuits; hydraulics; washing plants; water treatment plants; machine lubrication, etc.

AUTO-KLEAN MICOM (3)

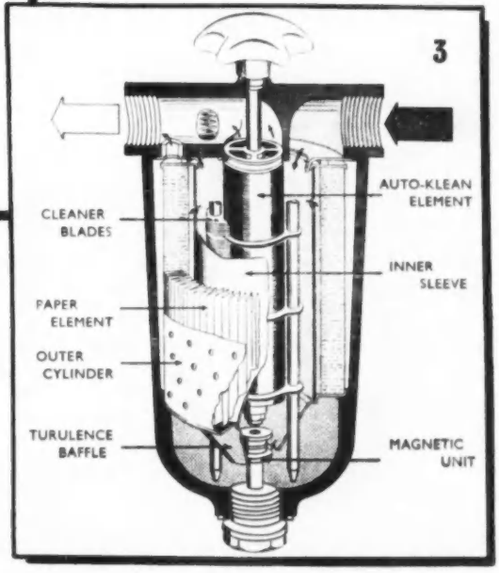
The MICOM combines the advantages of paper as a clarifier with the efficient characteristics of an Auto-Klean, self-cleaning, plate-type element in a full flow filter.

Principle: The greater part of the fluid passes through the plate-type element, while the remainder is filtered by the paper. *The whole of the filtered liquid passes to the outlet side of filter,* thereby giving the maximum protection to the system. A magnetic unit is also incorporated as additional protection against micronic ferrous particles.

Advantages: Positive filtration is guaranteed despite build-up on paper element; paper cannot collapse through choking and therefore its lifetime is increased; constant pressure is maintained as build-up on paper increases . . . while the plate-type filter can be automatically cleaned by turn of the handle—without dismantling. Also important is the low pressure loss and small, lightweight construction of the MICOM.

Data: Working pressures up to 50 lb./sq.in. Can be supplied with ratchet gear for link drive from moving mechanism.

Typical Applications: Ideal for diesel engine lubrication systems of the medium horse-power range and other similar recirculatory applications.



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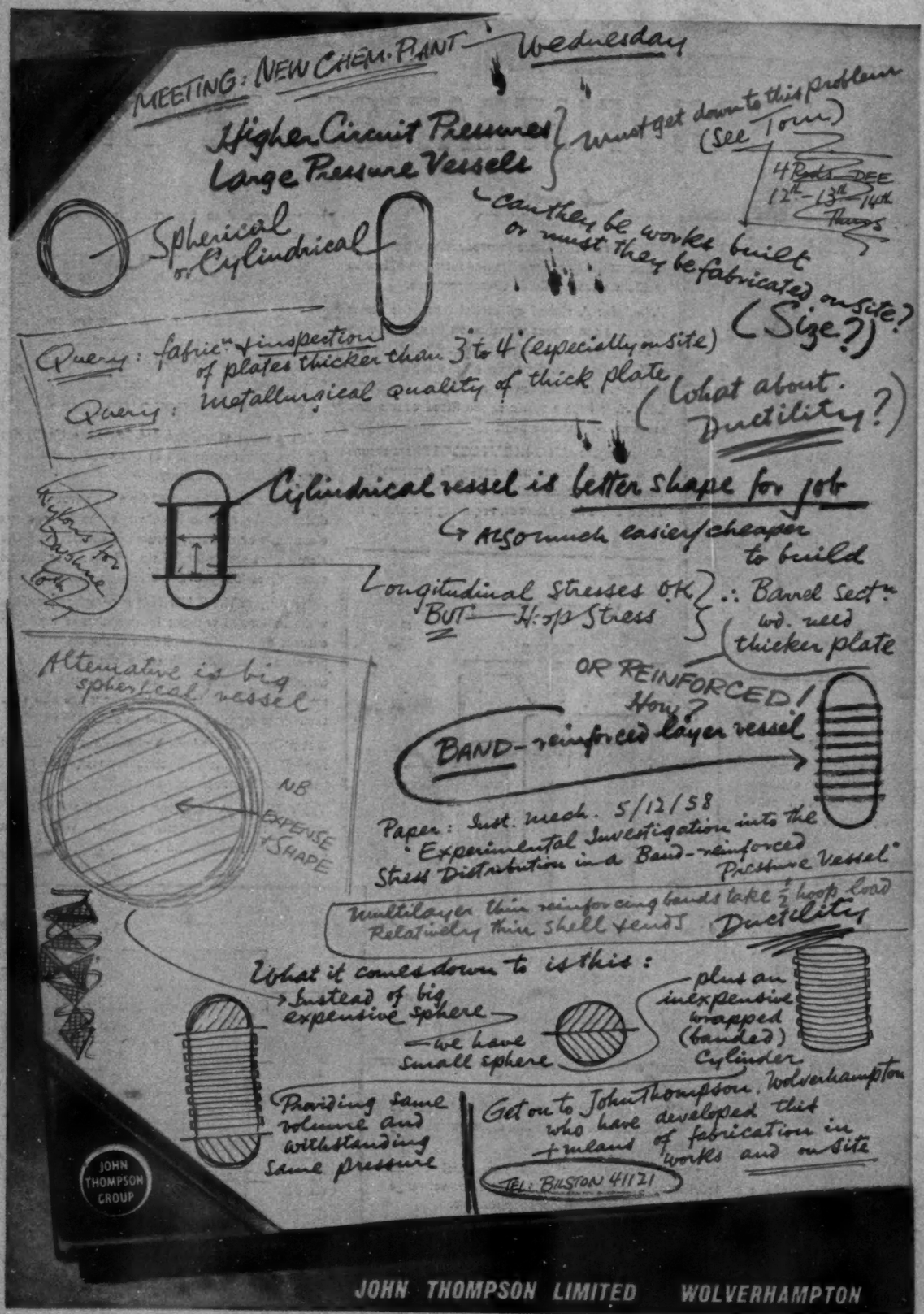
MEETING: NEW CHEM. PLANT — Wednesday
Higher Circuit Pressures
Large Pressure Vessels
must get down to this problem (See Town)
4 Rooks DEE 12th-13th-14th Thurs.
Spherical or Cylindrical
can they be works built or must they be fabricated on site? (Size?)
Query: fabrication + inspection of plates thicker than 3" to 4" (especially on site)
Query: metallurgical quality of thick plate (what about Ductility?)
Cylindrical vessel is better shape for job
Keyhaven Gas Turbine Work
also much easier/cheaper to build
Longitudinal stresses O.K. BUT — H.T.P. Stress
∴ Barrel sect.n wd. need thicker plate
OR REINFORCED! How?
Alternative is big spherical vessel
NB EXPENSE + SHAPE
BAND-reinforced layer vessel
Paper: Inst. mech. 5/12/58 "Experimental Investigation into the Stress Distribution in a Band-reinforced Pressure Vessel"
Multilayer thin reinforcing bands take ½ hoop load
Relatively thin shell tends Ductility
What it comes down to is this:
Instead of big expensive sphere
we have small sphere
plus an inexpensive wrapped (banded) Cylinder
Providing same volume and withstanding same pressure
Get on to John Thompson, Wolverhampton who have developed this + manufacture of fabrication in works and on site
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